High Voltage Measurements by Means of the Sphere Gap—Opportunities for Electrical Engineers in the Telephone Field, and other articles of timely engineering interest.

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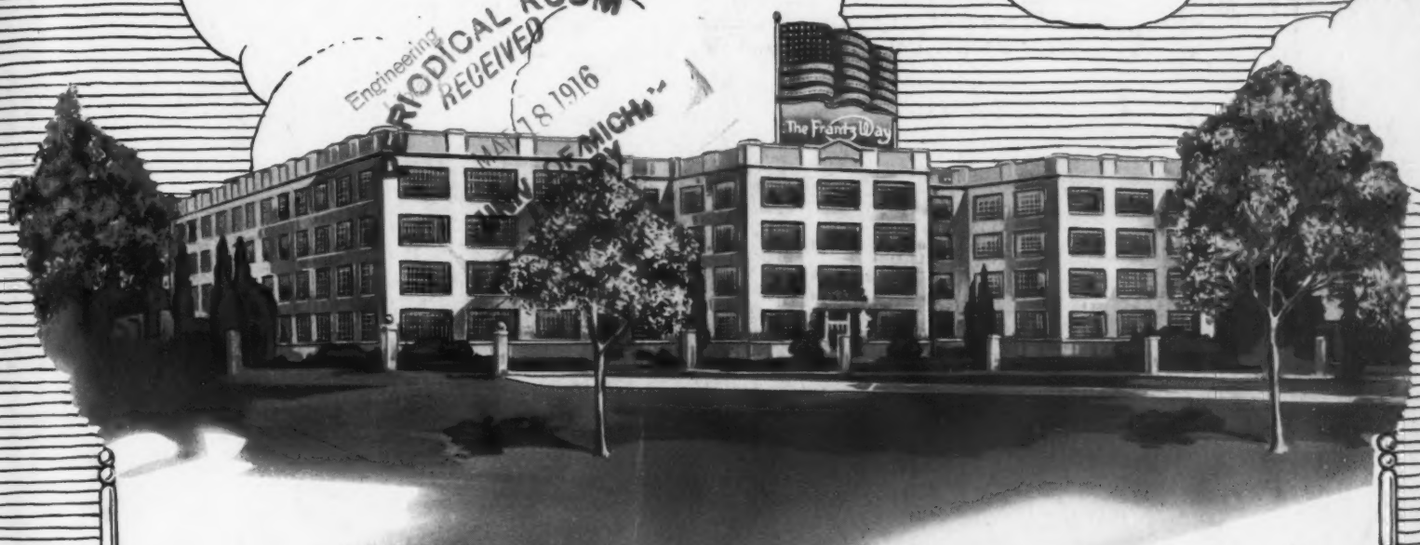

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Unto the Least

THE fallacy of slighting small consumers has often been demonstrated. Too frequently have managers in large cities been at pains to show that small-residence loads were being carried at a loss and to insinuate that such customers were *personæ non gratæ*. This, fortunately, is not true of the great bulk of the central stations of the country, because small-residence customers are about all that most of them have. However, it is well at this time to bring this small-customer question home forcibly to managers of large systems. They should know that discrimination in public service is abhorrent to common law and is an evil at which all regulatory measures are aimed. While it is natural to think well of one's best customers, that should be no reason for thinking ill of others whose accounts are not so large. Public service commissions seldom forget that they are the creatures of governors and legislatures, and that these in turn are amenable to the will of the very citizens referred to above. Moreover, some service is expected in return for franchises, and the burden of recent decisions is that none but the best service will be acceptable. As indicative of the importance of serving the small customer adequately and at reasonable cost, we call to mind a famous rate case just settled. The basis of settlement hinged chiefly on the rights of the small-residence consumers. The commission showed no anxiety for the largest consumer, nor yet for the average, but for the smallest. It was recognized that the first has a remedy in an isolated plant, that the second seldom has cause for grievance, and that the last is absolutely without remedy except by an appeal to the vested authorities. Therefore, in so far as the needs of residence customers are met, only just so far have good relations with the community been established. The taxpayer and voter can demand service as a right, and to give it to him at reasonable cost is expedient. The good will of its small customers is a priceless asset to any public service corporation.

Better Factory Lighting

AT a combined meeting of the Illuminating Engineering Society and the American Society of Mechanical Engineers recently held in New York City there was again made evident the opportunity for cooperation between the two organizations to further the principles of better industrial lighting. The Illuminating Engineering Society has developed a factory lighting code which must now stand the test of practice. Both mechanical and electrical engineers of industrial plants have the opportunity to take this code as a guide to lighting practice in laying out new buildings or remodeling old plants. Good light has come to be recognized as a fundamental consideration in increasing factory output. Glass-walled factory buildings have become commonplace in the last few years and the standards of natural lighting are much higher than formerly. Building designers, while recognizing the importance of natural lighting in industrial plants, have not always had the same viewpoint in the working out of plans for artificial illumination. Discussion between the men who know the problems both from the standpoint of illuminating design and from that of factory management will help materially the cause of better factory lighting.

Making the Most of Opportunities

IN his annual report to the stockholders of the American Telephone & Telegraph Company Theodore N. Vail calls attention to the engineering feats of transcontinental telegraphy and wireless telephony made by the company during the past year. These noteworthy achievements serve to emphasize the tremendous advantage of the Bell system, of its central administration and its centralized control of operating policy and methods, together with the work of its departments of operation, construction and manufacturing, and of research demonstration and development in the fields of economics, practice and science. The feats mentioned would have been impossible without this central cooperative, co-ordinating control of the entire system. It has been well stated that the independent efforts of segregated systems would have failed to produce satisfactory results; the duplication of work would have involved confusion and disturbance beyond endurance, and would have called for immense expenditure. Transcontinental telephony involved an application of the highest type of engineering, necessarily efficient and economical, to make possible such a great achievement at comparatively little cost.

Owing to centralization of control and engineering effort, advantage can be taken of every opportunity for effecting a saving, and it is here that the Bell system differs from others in the telephone field. In the power-transmission field we have in this country numerous interconnected systems which might be operated at enormous advantage if they were under single control and ownership. The great systems of the South, though interconnected, are at present powerless to effect great operating economies because of the independent ownership of the several systems. One system can feed a cer-

tain amount of energy into another system, but that is all. A hydroelectric company east of the Appalachian Mountains cannot take advantage of an abundant rainfall west of the Appalachians, nor can it take advantage of the investment made in steam equipment by an interconnected company in a neighboring state. This condition is also true of the interconnected systems on the Pacific Coast leading into San Francisco.

Were all of the interconnected systems in a district to be operated by a single head, it would be possible to shut down many stations during certain periods of the year and operate others at maximum efficiency and output. Some companies in the group might also avoid the necessity of making heavy investments in steam equipment by utilizing the steam equipment of their neighbors. In other words, if the companies pooled all of their generating equipment and placed the operation of it in the hands of a competent engineering committee, great savings could be effected. The same is true of the generating equipment in large cities There can be no doubt that if all of the public utilities having generating stations in the city of New York were suitably interconnected and then operated as one system, the saving in coal made possible by the more economic operation of the various stations would be enormous. Eventually, some master in the industry will place such a plan in operation, and it is safe to say that if rates for electricity are to show any decrease in the face of increased cost of material, and with the practical limit of thermodynamic efficiency almost in sight, some such solution must be forthcoming. Certainly, the electric-lighting industry has much to learn from the telephone industry in this respect.

The Engineer in the Preparedness Program

IN the gathering of forces for national defense the engineer must obviously play an important part, and the various societies and individuals that have to do with the engineering professions have shown themselves fully ready to respond to any call that may be made upon them. The chief problem in the utilization of this great body of technical ability is how to make its services fit in with the general plan of organization for defense. In foreign nations, where the whole resources of the country have long been assembled in due order for service in case of hostilities, there is no particular trouble in working out an efficient solution. Reserve officers of technical qualifications are carefully stationed beforehand where their abilities will do the most good, and every effort is made not only to muster the whole body of technical skill available in the country but to prearrange it so that every man may be used as efficiently as is practicable. This organization extends not only to those who are technically liable to active military service at the outbreak of hostilities, but also to those who belong in the last line of reserves but who can be utilized earlier with advantage to the country.

Germany, with that genius for organization which has not been equaled, much less surpassed, since the days of imperial Rome, knows superlatively well how to do this particular kind of thing. For instance, it has been reported, apparently on the best authority, that a group of skilled meteorologists and astronomers from the observatories of Potsdam and elsewhere have been put to work organizing a special meteorological service to guide the air raids of the zeppelins. And in every branch of engineering it will be found that experts have been put on the job—those capable of active military service on the work which requires such capabilities, those of the Landsturm and men unfitted for active service to tasks where their experience and abilities can be efficiently employed.

The work of organizing the engineering forces of this country to meet possible exigencies will have to be conducted along somewhat similar lines. It is not merely sufficient to raise a few engineer regiments, organized in the ordinary way, however valuable such a step may be in itself. Means should be found for giving the necessary special training to, and commandeering for service when necessary, great numbers of technically trained men whose abilities can be put to suitable service. For example, some means should be found for placing in case of need at the head of transportation work old hands who know the railway systems as a small boy knows his pockets and who can deal with the thousand problems of mobilization promptly and efficiently. It is not sufficient for the quartermaster's department to go to the ordinary railway manager and tell him what its requirements are and what it wants to accomplish if possible. We tried that process during the Spanish War with lamentable results. What is necessary is that railway men of long training should be actually in the service of the United States and so conversant with the requirements of mobilization that when necessity arises they can be put in full command of the situation with the certainty that the resources commandeered will be utilized to the best advantage. In case of food supply it is not sufficient for the quartermaster's department to send out bids and accumulate all the ancient tinned provisions unsalable for the last decade, but some experts should be on hand and in the actual service of the United States who would know where to go and would cause to be promptly assembled whatever the army might need. The hugeness of the problem involved in putting half a million or a million men into the field swiftly and efficiently almost staggers the imagination, even when these men have been long since enlisted and trained. Beyond this the raising of a volunteer army involves tasks still more prodigious. The gathering of technically trained reserves and their distribution to the tasks for which they are best fitted is one of the most difficult of the many obstacles which stand between the will and the deed in practical preparedness. The work fundamentally belongs to the general staff; secondarily provision must be made for empowering that staff to effect the necessary organization. The engineers of the country are a unit in wishing to help. In order to make that help effective there must be, reaching down from general headquar-

ters, a plan of action worked out in advance and backed by sufficient authority to make it effective. Next to the immediate and necessary steps of increasing both the standing army and the federalized militia to a point where the joint force will be a respectably great one, comes this work of that general organization of resources of men and material which will enable every qualified man to put his abilities to the best possible use. No such plan of action has yet been initiated; in fact, it is too early as yet to do so. The first thing necessary is the passage of a suitable army bill which will give as quickly as possible available military forces, and then let come the legislation which can make use of the vast resources necessary in modern war which lie back of the man with the rifle.

Dealing with a Difficult Load

THE arrangements made for serving a large rolling-mill load by the Massillon (Ohio) central station, recounted in this issue, show how it is possible for a generating station of moderate rating to deal with the severe loads imposed by steel mills and similar industrial establishments. These heavy and fluctuating demands for power cannot be properly met without the evolution of special methods to soften the shock of the huge, sudden calls for energy. That the task can be successfully accomplished is in evidence in the article before us. So far as energy supply is concerned it seems at the first glance almost like the tail wagging the dog, yet by skillful engineering and special devices of several sorts the feat has been accomplished, and one has the interesting spectacle of a 3200-kw. turbine plant handling loads often rising as high as 5000 kw. without demoralizing the regulation. The central station took this power contract when it was possessed of substantially only 1200 kw. in a turbo-generator, and backed up its output before the crisis came by installing in addition a 2000-kw. turbine with ample boiler capacity and accessories. To meet the exigencies of load a bank of ten lamps is installed for each turbine with contactors attached to the turbine governor, so that a reasonably close indication of load is regularly indicated in the boiler room and the firemen can govern themselves accordingly when a period of unusually severe demand begins. The steel mill is about 7000 ft. away from the central station, and supply was undertaken at 2300 volts, using twelve No. 4/0 wires; but when the steel mill was placed in operation it turned out that the power demand had been very much underestimated, it being much more nearly 4000 kw. than 2000 kw., so that arrangements were immediately made to add a 5000-kw. turbine and also to raise the energy for transmission to 11,000 volts to decrease the trouble from voltage drop.

The most interesting part of the installation, however, in its relation to steadying the load, is at the rolling mill itself. The main motor of the great blooming mill is fed with energy from an induction motor-generator equipped with a very heavy flywheel. This motor-generator and the big motor itself are so excited that peak energy is taken up from the flywheel, thus steadying the external load. The reversing motor for the mill is connected solidly in on the generator terminals without any control apparatus, and the speed is regulated by changing the excitation of the generator field, both generator and reversing motor being separately excited from a motor-driven exciter. By this system of varying the excitation, acceleration and retardation are quite gradual, so that the heavy strains, mechanical and electrical, are greatly relieved, and at the end of each pass of the ingot the generator field is de-energized and the motor works regeneratively, pouring energy into the generator set and speeding up the flywheel preparatory to the next pass of the ingot. Experience shows that about 70 per cent of the energy required for acceleration on the rotating parts of the mill is thus regained. A special slip regulator is provided which automatically varies the resistance in the motor-generator motor secondary, so that when the current tends unduly to increase, the slip regulator eases up the normal slip of the motor-generator set and brings the flywheel into play. So successfully has this scheme of regulation worked out that, in spite of peaks nominally of 8000 hp., the input on the main alternating-current motor does not go above 1200 kw. Energy is furnished to the rolling mill under a sliding-scale demand and energy system, the demand being taken as the average of the five highest five-minute demands during the month, and a guaranteed average price, varying at different times of the year, has been established contingent on the mills not calling for full power on the general peak. The article will well bear study in detail as throwing light on one of the difficult problems of motor supply in dealing with especially heavy loads on a system of relatively moderate capacity.

The Coming Issues

NEXT week's issue of the ELECTRICAL WORLD will be the commercial number for March. Coming at a time when the "Wire-Your-Home Month" campaign is in full blast, it will present the stories of a number of successful house-wiring campaigns, pointing out in particular how the influence of the movement can be extended to the house-wiring months to come. Among the wholly new house-wiring schemes to be described is the method employed by one thinking central-station manager by which a local bank finances the cost of customers' wiring installations. The "electric flag" movement, lighting and motor applications, licensing of electrical workers, credit and payment conditions in the industry, etc., are some of the timely topics which will hold interest for the central station, the contractor, the dealer, the jobber, and the manufacturer. A contribution by Val A. Fynn on the subject of single-phase commutator motors closes the discussion on the nomenclature of these machines which has been running for some months in these columns. The public-relations number of April 1 will follow, and in turn the station-operating and engineering issues of April 8 and 15 respectively.

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

E. V. A. Becomes Electric Vehicle Section of N. E. L. A.

At a specially called meeting of the Electric Vehicle Association of America, held at New York on March 10, the members of the organization formally voted to accept the invitation of President E. W. Lloyd of the National Electric Light Association to affiliate with the latter as its electric-vehicle section. Brief addresses were made by W. H. Blood, Jr., the first president of the Electric Vehicle Association, Past-president F. W. Smith, Jr., President W. H. Johnson, and Secretary T. C. Martin of the N. E. L. A. Arrangements are now being made to combine the office staffs of the two organizations, and Secretary A. J. Marshall of the E. V. A. will transfer his headquarters to the N. E. L. A. offices as secretary of the new association section.

Western Utilities Object to Lower Discounts to Jobbers on Ranges

With few exceptions the large central-station companies on the Pacific Coast approve the protest now being made to manufacturers against the recently announced revision of discounts on electric ranges whereby the jobbers will buy at lower prices than the central stations. The changes are understood to mean that the central stations will be obliged to ask consumers a higher price and also to handle the ranges on less margin. In support of the protest it is pointed out that the sale of electric ranges calls for special talent and methods. Expert salesmen are necessary and they must go out after the business. The case is entirely different from that of popular socket appliances, because these are articles of recognized value and usefulness, while the electric range is an innovation and can be introduced only after a considerable amount of education and demonstration.

The central station, it is maintained, has two motives in making range sales—profit in the sale itself and increased market for electricity. The jobber, whose only profit is that involved in the original sale, cannot be expected to give the electric-range situation adequate attention. One operator points out that the criterion by which electric ranges are judged is service. The sales must be followed by the visits of an expert in cooking by electricity, parts that develop defects must be replaced willingly, and in every way possible the new customer must be encouraged to give the range a fair trial. The importance of doing all this with the utmost care cannot be overestimated because the first few hundred sales now being made will make or destroy prospects for the thousands next in order. Under these conditions it is intimated that central stations are unwilling to intrust the future of the range business to co-operative selling plans until it has been demonstrated that such plans are entirely feasible.

The percentage of sales which have been made thus far by jobbers, it is claimed, has been almost negligible, while, on the other hand, central stations are laying plans for conducting their own campaigns along lines best suited to the territory and load characteristics of each. Every Western central station has sold some ranges—enough to put itself on record as to prices. A slight increase in price due to readjustment of patent royalties might possibly be absorbed by the central stations in order not to influence unfavorably the introduction of the ranges; but it is pointed out that if the manufacturers, in addition to such increase, insist on discounts favoring the jobber this will undoubtedly discourage the central stations. In fact, some managers of utilities have already announced that if such a situation cannot be remedied, further efforts on their part to introduce ranges at this time must be deferred.

Water-Power Situation

President Wilson has announced in Washington, through a letter to Representative Kent, that he is watching the progress of water-power legislation with a great deal of anxiety, and that "it is better to let the water-power run to waste than to settle the question of the use of it in the wrong way." In some quarters this is taken to mean that the President may veto the Shields bill recently passed by the Senate, if it should be passed by the House, of which there is some doubt, as the Shields bill is a substitute for a bill passed by the House totally different in many important features which it is not believed that the House will accept.

The attitude of Mr. Baker, the new Secretary of War, toward water-power matters is expected to play an important part in what is done about water-power legislation at this session. President Wilson has also announced that he purposes to take up the subject of water-power matters with the new Secretary at the earliest possible moment, and the latter is expected to familiarize himself with them and report to the President shortly.

Debate was begun in the Senate Tuesday on the Myers bill dealing with water-power sites on public lands. That bill is now the business of the Senate except that the armor-plate bill will come up by unanimous consent for a vote on March 21. Senator Thomas endeavored to prevent the adoption of a motion to proceed with the consideration of the Myers bill, which is also known as House Bill 408, without success. During the debate Senator Smith of Georgia declared that if Senators from Western States could only agree among themselves as to what they want in water-power matters "the rest of us would be very much disposed to support them."

Senator Shafroth announced that the governors of the Western States are very much opposed to the leasing system proposed in the bill, and stated specifically that there is opposition to the bill from the two Senators from Colorado, the two Senators from New Mexico, the two Senators from Wyoming, the two Senators from Idaho, the two Senators from Utah, and as to the remainder of the Western States, at least one Senator from each State is opposed to it with the exception of the two Senators from Montana.

Senator Thomas then practically served notice that a filibuster would be used against the bill if its consideration were forced. Nevertheless the consideration of the measure was forced.

In a statement given out in Washington concerning the passage by the Senate of the Shields bill, Gifford Pinchot, president of the National Conservation Association, said:

"No worse assault on the rights of the people has been committed in Congress for many years than the passage of the Shields water-power-grabbing bill. The water-power monopolists won. The people lost because a majority of their representatives in the Senate went back on them. This special-interest bill could not have passed if the press and the public mind had not been absorbed by the international crisis."

Ohio Commercial Men Discuss Customers' Complaints, Residence Wiring, Industrial Trucks and Steam Heating

In welcoming to Springfield the delegates to the convention of the new-business co-operations committee of the Ohio Electric Light Association, March 15, Weare Parsons, treasurer and manager of the Springfield (Ohio) Light, Heat & Power Company, suggested that the name of that committee be changed to some title more inclusive of the comprehensive work of the organization. The central-station industry has progressed so far in Ohio, said Mr. Parsons, that the work of the new-business committee should be broadened, including among other things the adjustment of customers' claims against the companies.

Mr. Parsons spoke of the remarkable industrial growth of Springfield and declared that during the next two years the city would show still greater gains. He said that Springfield's new ornamental lighting would be ready for operation in about ninety days.

J. E. North, commercial manager of the Springfield company, cited as evidence of Springfield's industrial activity the fact that the local connected power load has grown from 1300 hp. to 9000 hp., and that the electric-appliance business had increased 4000 per cent in the last six years. The point developed in the discussion that there is considerable difference of opinion among the commercial men as to whether or not customers' claims against a utility company should be handled by the sales department. That all dealings with the larger power customers should be handled by salesmen seemed to be generally conceded, but the discussion of the ideas advanced as to the best methods of handling claims of small customers seemed to show that methods which are valuable in smaller towns cannot be made to apply in larger cities. The men from the smaller cities favored putting this work in the province of the commercial department, while representatives of larger companies favored separate adjustment or complaint departments.

The papers on the program dealt with residential service, industrial trucks, and steam heating as an aid to securing more business. The liveliest interest centered about the house-wiring question, and it was evident from the trend of the discussion that practically all of the delegates present have laid definite plans for participating in the national "Wire-Your-Home Month" campaign. Abstracts of the papers and discussions at the sessions will be given in a later issue.

At the close of the meeting it was decided that the date of the Ohio commercial men's next meeting in Newark, Ohio, should be changed from May 17, as previously announced, to May 12 so that there would be less conflict with the date of the N. E. L. A. convention beginning in Chicago May 22. The meeting was adjourned early in the afternoon to permit delegates to visit the factory of the Robbins & Myers Company.

N. E. L. A. Conference Called on Valuation Problems

A conference on valuation problems of the public utilities has been called by President Lloyd of the National Electric Light Association for April 10 and 11 at the United Engineering Societies Building, 29 West Thirty-ninth Street, New York City. The conference grows out of a recent meeting of the public-policy committee of the association at which it was suggested that it would be desirable to have a meeting of Class A members of the association on this subject. H. L. Doherty has the program in charge.

A. I. E. E. Nominations

At the meeting of the board of directors of the American Institute of Electrical Engineers held March 10 the report of the committee of tellers on its canvass of the nomination ballots cast for candidates for the Institute offices falling vacant July 31, 1916, was presented. As required by the constitution of the Institute, the board then selected by ballot its list of "directors' nominees," with the following result:

For president—H. W. Buck, New York.

For vice-presidents—L. T. Robinson, Schenectady, N. Y.; Peter Junkersfeld, Chicago, Ill.; B. A. Behrend, Boston, Mass., and Henry A. Lardner, New York, N. Y.

For managers—John B. Fisken, Spokane, Wash.; Charles Robbins, Pittsburgh, Pa.; N. A. Carle, Newark, N. J., and Charles S. Ruffner, St. Louis, Mo.

For treasurer—George A. Hamilton, Elizabeth, N. J.

It will be noted that the board of directors placed upon the list of directors' nominees the names of four candidates for the office of vice-president, three of whom are to be elected. The ballots will be mailed to the membership prior to April 1.

Ontario Hydro-Electric Commission Gets Seymour Interests

On March 10 the Hon. G. Howard Ferguson, Minister of Lands, Forests and Mines, announced that the Ontario government had signed an agreement with the Electric Power Company, which controls what are generally known as the Seymour enterprises, purchasing outright on behalf of the people all the vast interests of that corporation—water-powers, development plants, transmission lines, local water and light companies, and an electric railway. The purchase is the result of negotiations carried on for some time, and the purchase price, $8,350,000, payable in Ontario government 4 per cent bonds, represents the amount actually invested in the various enterprises as agreed upon after thorough investigation by the engineers of the Hydro-Electric Power Commission.

Twenty-two companies have been taken over, including the Auburn Power Company of Peterboro, Ltd.; Central Ontario Power Company, Ltd.; City Gas Company of Oshawa, Ltd.; Cobourg Utilities Corporation, Ltd.; Cobourg Electric Company; Cobourg Gas, Heat & Water Company; Eastern Power Company, Ltd.; Light, Heat & Power Company of Lindsay, Ltd.; Napanee Gas Company, Ltd.; Napanee Water & Electric Light Company, Ltd.; Northumberland Pulp Company; Oshawa Electric Light Company; Otonabee Power Company, Ltd.; Peterboro Light & Power Company; Peterboro Radial Railway Company; Port Hope Electric Light & Power Company, Ltd.; Seymour

Power & Electric Company, Ltd.; Sydney Electric Power Company, Ltd.; Trenton Electric & Water Company, Ltd.; Tweed Electric Light & Power Company, Ltd.; Nipissing Power Company, Ltd., and North Bay Light, Heat & Power Company, Ltd.

All of these companies, with the exception of the Nipissing Power Company and its companion enterprise, the North Bay Light, Heat & Power Company, are in what is known as the Trent Valley district.

The Electric Power Company controls ten hydroelectric power plants having a total capacity of 60,000 hp. Its transmission system is 459 miles long. Kerry & Chace, Ltd., of Toronto were the managing engineers of the power company.

Compromise of Philadelphia Rate Case

Electric Company and City Agree to a Lower Rate Schedule Involving a Reduction of $1,000,000, Based on Earnings of Company Last Year

The Philadelphia Electric Company will make a general reduction in rates, beginning April 1. A compromise was effected March 9 at a final hearing before the Public Service Commission, whereby the company agreed to lop off $1,000,000 in the cost of its service to the municipality and other consumers. This cut was agreed to at conferences between attorneys representing the company and the city.

The compromise will result in the Philadelphia Electric Company making a considerable refund to the city treasury because of an agreement made in the early stages of the proceedings whereby it was arranged that whatever rates should be finally determined upon by the commission should apply, as affecting public lighting, to the rate charged the city from Jan. 1, 1915, until the decision of the commission was announced.

Compromise Agreement

The compromise agreement, as announced by Frederick W. Fleitz, former Deputy Attorney-General, who was the principal legal representative of the Philadelphia Electric Company during the hearings, is given as follows:

"It is proposed to make a radical change in the schedule and rates of the company for the service it renders to the community, which applied to and worked out on the total operating revenues of the company for the year 1915 will result in a reduction in the cost of service to the city and the consumers in Philadelphia of approximately $1,000,000.

"The rate found by this calculation and the schedule prepared thereon as applied to the business of the company throughout the city of Philadelphia in 1916 will, undoubtedly, further increase this saving to the consumer and the public. The schedule is now being prepared, and will be put in force if the commission approves as of the first day of April, 1916."

It was pointed out that the company's surplus for 1915, after dividends, totals $763,000, which is approximately $237,000 less than the $1,000,000 cut agreed upon in the compromise. Morris L. Cooke, who originally instituted the suit, declared there was no desire on the part of the complainants to cut into the company's dividends or to interfere in any way with its internal financial commitments. "We simply agreed with the Philadelphia Electric Company," said former Director Cooke, "to take the corporation's gross earnings of $7,849,267.67 and lop off $1,000,000. The plan then is to deduct this $1,000,000 from the rate receipts, making the reductions apply proportionately to all classes of business."

Statement from Complainants

William Draper Lewis, chief counsel for Mr. Cooke, agreed, on behalf of the complainants, to the suggested arrangement. He read the following statement:

"This commission is engaged in a task of great public importance and of great difficulty. I believe that you are entitled to ask those who come before you, whether they represent the consumer or the utility, to take the attitude that they are not litigants in the ordinary sense of that word but your assistants to help you perform your duty.

"Throughout the trial of this case, which has now lasted continuously for many weeks, the effort on the part of the complainants has been to place before you every fact which had any bearing on the matter of fair rates for electric light and power. The record as it stands is now sufficient to enable this commission to come to a determination of the rates for public lighting and for private lighting and power which should be charged by the Philadelphia Electric Company.

"I desire at this time to emphasize the fact that the completeness of this record is not alone due to the efforts of the complainants. Throughout the last fourteen weeks, had it not been for the hearty co-operation of the company and its action in placing before you all facts within its knowledge, the record would not now contain, as it does, sufficient information on which to readjust the rate schedules of the company.

"I think you, Commissioner Monaghan, will bear me out when I say that throughout the last part of this long trial the representatives of the complainants and the respondents have not been carrying on a contest before you, but that in effect we have met with you around this table, each in all sincerity trying to get at the facts.

"Having completed placing upon the record all the facts necessary to reach a just conclusion in this case, it was natural that the representatives of the company and the complainants should go over the facts developed at the trial, with a view of ascertaining whether we could not make you a definite suggestion in regard to the readjustment of rates. As the result of conferences in which the entire evidence on the record has been takn into consideration, we are now in a position to make the following suggestions:

"That the commission now enter an order on the company to file with the commission, within two weeks, a readjusted rate schedule, which schedule will reduce the amount now charged under existing rates, and the amount of the total reduction, as applied to the gross income from the sale of electric light and power for the year 1915, shall be $1,000,000.

"Should you make the order suggested, I have no doubt, in view of the present spirit of co-operation between the commission and the parties to this case, that no difficulty will be experienced in putting in force, perhaps as early as April 1, a rate schedule which will equitably apply—in view of the facts brought out in the course of the trial of the case—the reduction agreed upon between the different classes of consumers of electric light and power."

Continuing, Mr. Lewis said:

"The company has always given to its customers efficient service. With fair rates established, the citizens of Philadelphia should, and I believe will, recognize the fact that they, as citizens, are personally interested in the prosperity of the company and will co-operate with it in all its efforts to increase its business and extend its facilities."

Morris L. Cooke in a statement afterward issued said of the Philadelphia Electric Company that "a cut in gross revenue of more than 12 per cent under all the conditions will necessarily bring changes and readjust-

ments in many directions. I believe that almost without exception these mean only added prosperity for the stockholders of the company and for its employees as well as for the city. It should be the wish now of every citizen of Philadelphia, as it is of the complainants in this case, to co-operate in every possible way with Mr. McCall, the president of the company, and his associates in making these changes in rates lead to the largest possible measure of prosperity."

HISTORY OF THE CASE

The petition asking the commission to investigate the Philadelphia Electric Company rates, with a view to ordering material reduction, was originally filed in the fall of 1914, and the case was opened on Nov. 17 of that year.

There were sixty-six sessions of the commission during the hearings, and experts of nation-wide prominence in the utilities field were called on to testify. These included Messrs. D. C. & W. B. Jackson, Sanderson & Porter, Dr. W. McClellan, Milo R. Maltbie and F. W. Ballard. The total cost to the Philadelphia Electric Company is said to have been in the neighborhood of $200,000. Just 110 volumes of testimony were taken, covering 8500 pages.

The new tariffs will not be made public until they have completed and approved by the commission. It was announced, however, that the small consumers of light and power are to benefit more, proportionately, than the large consumers.

Annual Report of Bell System

With a Gross Revenue of $239,900,000, President Vail States Companies Were Never in a More Satisfactory Financial and Physical Position

That the American Telephone & Telegraph Company and associated companies were never as a whole in a more satisfactory position financially, physically, and particularly in their mutual relationship with the public, is clearly shown in the annual report of President Theodore N. Vail, just issued.

The Bell system now connects 9,151,221 telephones, a gain of half a million stations in the past year. The total wire mileage owned is 18,500,000, of which 10,500,000 is underground. There are nearly 200,000 miles of phantom circuits which carry an overload from the wire circuits, and 8,652,400,000 telephone connections were made during the year.

The revival of general business is reflected by a growth of 225,300 subscribers' stations in the second half of the year, as against 125,900 during the same period in 1914. The Bell system has been able to respond quickly to the demands made because of its policy of providing plant in advance of requirements.

The net permanent capital obligations of the whole system outstanding in the hands of the public is only $736,156,756, although the telephone plants stood on the books on Dec. 31 at $880,068,520 and their appraisal value is over $61,000,000 in excess of the book value. There was $32,863,717 added to plant and real estate last year and it is estimated that $57,000,000 will be spent in plant additions during the current year.

The gross revenue in 1915 of the Bell system, not including the connecting independent companies, was $239,900,000, an increase of over $13,900,000 over last year. Of this, operation consumed $84,500,000, taxes $13,100,000, or 1.64 per cent on the outstanding capital obligations, current maintenance $31,200,000, and provision for depreciation $44,900,000. The surplus available for charges, etc., was $66,200,000, of which $18,100,000 was paid in interest and $32,900,000 was paid in dividends.

During the past eight years the gross earnings have increased $111,300,000, while the assets have increased nearly $445,000,000, with an increase of capital obligations and payables outstanding of only $273,600,000.

In the three years 1913-1915 inclusive the expenditures from the benefit funds of the Bell companies have aggregated $3,779,896. The reserves for this fund are $9,114,329, and during 1915 the payments for pensions, sickness, accident and death benefits were $1,397,742.

The net earnings of the American Telephone & Telegraph Company for the year were $41,117,487. The interest charges were $6,498,849, and the dividends at the regular rate of 8 per cent per annum were $29,100,591. Of the resulting balance there was carried to reserves $2,500,000 and to surplus $3,018,046.

The number of stockholders, 65,512, not including the 32,000 "employee" shareholders who are paying for stock out of their wages, shows an increase of 6097. The majority of the company's shareholders are women. The financing for 1916 was taken care of by the sale of $50,000,000 4.5 per cent coupon notes.

The formal opening of the transcontinental telephone line from Boston and New York on the Atlantic seaboard to San Francisco on the Pacific on Jan. 25, 1915, has been followed by the extension of "extreme-distance" transmission into all the states of the Union, and the necessary changes in plant and equipment will be continued to make it possible for any subscriber to talk with any other subscriber regardless of distance. This is being done by smoothing and easing the transmission over the long lines, and therefore necessitates no change in the subscriber's telephone or local line. Considerable space is also given to developments in wireless telephony and telegraphy.

Mr. Vail says that the relations of the associated companies with the various boards of control and regulation have been most satisfactory, but that the operations of these bodies should be strictly confined to control and regulation and never invade the managerial province.

The Bell companies have been foremost to establish and propose to continue their efforts to maintain good wages and good working conditions for their employees, a condition of the utmost importance to efficiency of the service to the public. He shows that since every legal safeguard has been thrown around employees, a combination of employees leading to the suspension of the service and the inconvenience of the public should not be possible. "Such action on the part of the employees of a public utility is as unjustifiable and unpardonable as would be an arbitrary suspension of service by the utility."

In speaking of the relations of the Bell companies with the general public, Mr. Vail in concluding says:

"With a reasonably satisfied public, with a reasonably liberal public, with a reasonably inclined federal, state and municipal control and regulation, without any onerous or unreasonable demands in sight or probable, with a normal business requiring only normal amounts of future capital, with a system sufficiently in advance of existing conditions to meet all possible demands or exigencies, with a business of such a nature that it makes the most economical 'servant' for social or commercial intercourse, the first to be employed, the last to be discharged, with an operating staff from office boy to senior executive, from newest to oldest, who look upon the system as their system, who are jealous of its reputation and zealous in support of it, who have a keen interest in its improvement and development, who believe that their success and the company's success are inseparable, who are never satisfied except with something better and who recognize their obligations to the public—with all these, we should look forward with confidence to the future."

Serving an 8500-Hp. Steel Rolling-Mill Load

Redesign of a 1600-Kw. Central Station to Serve a New Customer with a 4000-Kw. Peak Demand—Methods of Overcoming Objectionable Features of Rolling-Mill Loads

WHEN the Central Steel Company of Massillon, Ohio, built its new mill calling for about 8500 hp. in motive power with provisions for doubling this in the near future, an interesting and complicated engineering problem confronted the Massillon Electric & Gas Company in considering the possibility of connecting the mill load to its system. The connected load of this plant at the time was equivalent to several times that served by the generating station and would have called for expensive changes and additions to the generating facilities. The central-station company had already undergone two stages of rehabilitation in which four old rope-driven units had been supplemented by a 400-kw. alternator and these in turn had been superseded by a 1200-kw. Westinghouse condensing turbo-generator; but the latest unit did not have enough extra rating above the average load to carry even a small percentage of the prospective load. In spite of these conditions the electric-service company closed a contract with the steel company to supply energy for all power purposes, including electric welding, steel rolling, shearing, etc., calling for a demand of 2000 kw. and reconstruction work was again started.

Changes in Generating Station

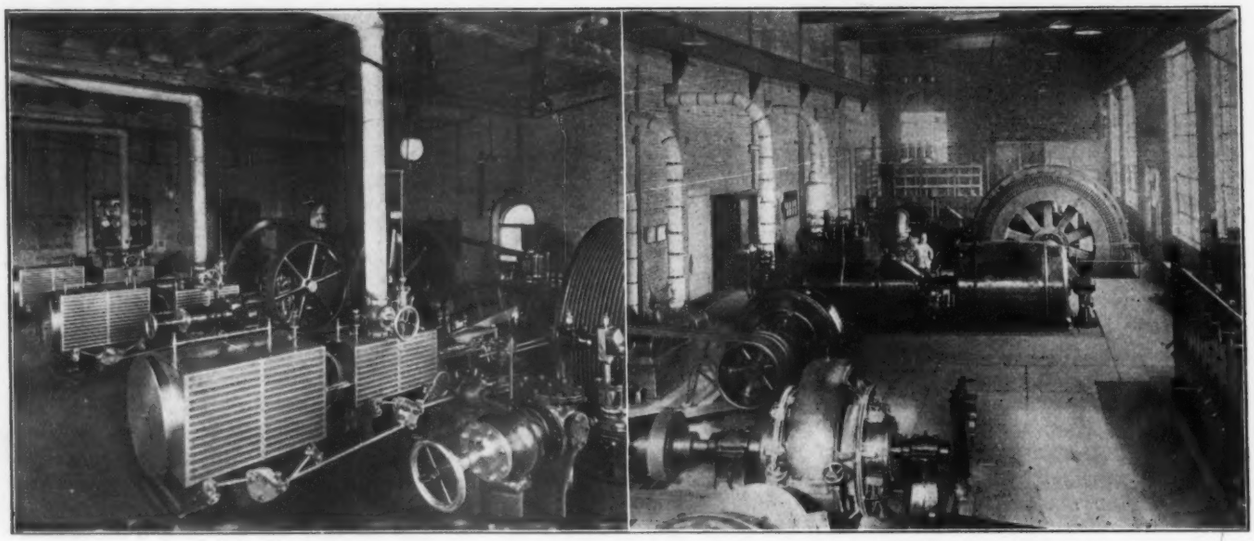
The boiler plant, which contained one 416-hp. Stirling boiler and one 513-hp. Heine unit, was extended by making a 50-ft. by 50-ft. addition and installing two 500-hp. Stirling boilers. The engine room was likewise enlarged by about 3000 sq. ft. to accommodate a 2000-kw. Westinghouse turbine, a 4000-hp. Stillwell feed-water heater, turbine-driven feed pumps, motor-driven hot-well pumps, a new steam piping system and a 160-ft. steel stack.

Since the initial demand of the steel mill was estimated at 2000 kw. and energy had to be transmitted about 7000 ft., twelve No. 4/0 wires were strung between the station and the steel mill and provisions made for transmitting at 2300 volts. When the steel plant actually commenced operation, however, the power demand proved to be nearer 4000 kw. than 2000 kw., thus making it necessary for the 3200-kw. turbine plant to carry with its other industrial and lighting load peak loads frequently as high as 5000 kw. While no trouble resulted from this overloading, immediate steps were taken to install a 5000-kw. turbine-driven set beside the last addition to the plant. Difficulty did arise, however, from excessive voltage drop in the transmission line due to the overload. To remedy this trouble outdoor substations containing five 2000-kw. single-phase transformers are being installed so that the energy may be transmitted to the mill at 11,000 volts. When these substations are completed, six of the twelve conductors can be taken down.

In all, the company has a connected motor load of about 13,700 hp., about 8500 hp. of which is supplied to the mill of the Central Steel Company. Just what proportion of the total plant load the steel-mill load is can be judged from the accompanying typical daily load curve. According to this record, the total energy generated for the period shown was 37,190 kw.-hr. Of this amount 23,200 kw.-hr. was delivered to the steel mill. The maximum demand was 4900 kw., and the daily load factor was 31.62 per cent.

Provisions for Handling Rolling-Mill Load

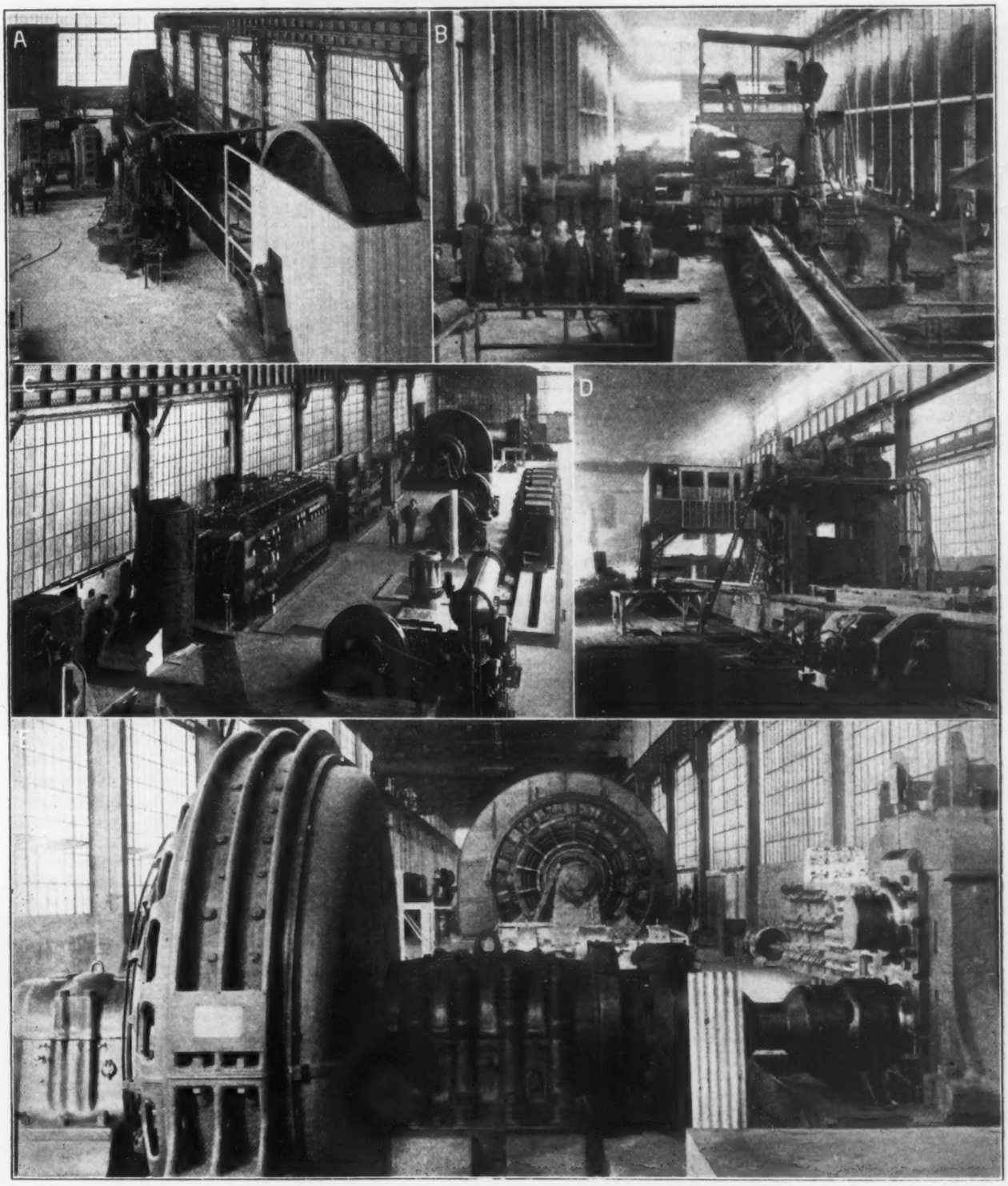
The objections which many central-station companies raise to rolling-mill loads (extreme fluctuations and consequent disturbing effect on line voltage) have been overcome to a great extent at the Central Steel Company's plant by supplying energy to the main motor of its mammoth blooming mill through a flywheel induction motor-generator, regulating the slip of the latter, and so exciting the motor-generator and blooming-mill motor that peak energy is absorbed from the rotating flywheel, minimizing the disturbances to the external electric system. Another feature of the installation is that the blooming-mill reversing motor is connected



FIGS. 1 AND 2—OLD GENERATING EQUIPMENT AND APPARATUS WHICH HAS REPLACED IT

The reciprocating units drove generating equipment, including brush-arc machines, through a maze of shafting and rope transmission. All this has been replaced by turbo-alternators which furnish most of the energy directly, direct current being supplied by motor-driven generators or by constant-current transformers and mercury-arc rectifiers.

Some of the Applications of Motor Drive in Massillon (Ohio) Steel Rolling Mill



A—Rope transmission from 1500-hp. motor driving bar mill shown in *B*. *B*—Bar mill operated by motor on left and controlled by operators stationed in pulpit above rolls. *C*—Portion of motorhouse showing motor end of flywheel motor-generator set in background with rotary converters nearer foreground. *D*—Blooming mill whose rolls are driven through gearing by motor shown in *E* and which is controlled from pulpit above bloom carriage. In this pulpit are master controllers for fifteen motors having an aggregate rating of 2530 hp. These handle the blooms from the time they are laid on the approach table by cranes until they have passed through the rolls about nineteen times and been delivered to the bar mill. The separation of the rolls, which is indicated by the large micrometer head above them, is performed by two of these motors. *E*—A large direct-current motor having a flywheel effect of about 670,000 ft.-lb. at 47 r.p.m. that drives the blooming mill illustrated in *D*. The motor windings are cooled by forced air circulation maintained by motor-driven blowers. The motors, generators and heavy apparatus were supplied by the Westinghouse Electric & Manufacturing Company, with some of the electric control furnished by the Electric Controller & Manufacturing Company and the Cutler-Hammer Manufacturing Company. The cranes are of the Alliance and the Morgan Engineering Company types, and the lighting equipment was supplied by the Holophane Company and the Benjamin Electric Company. The rope drives employed in the bar mill were made by the Mesta Machine Company.

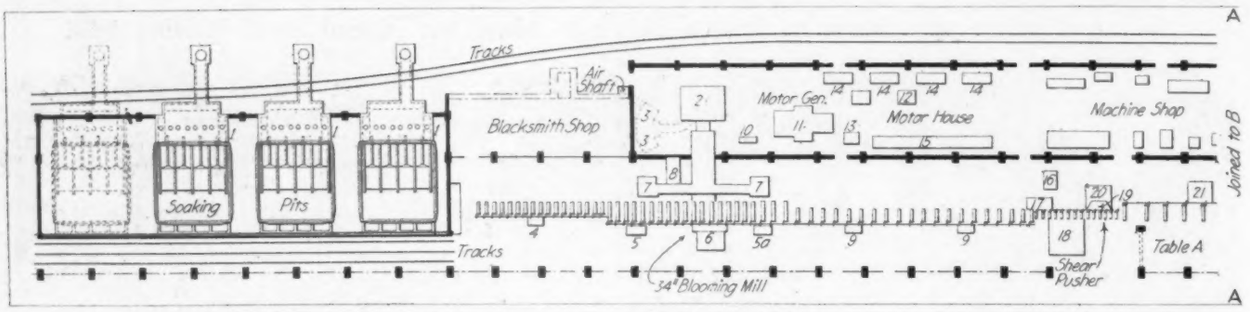


FIG. 3—SOAKING PIT, BLOOMING MILL AND SHEARING SECTION OF MASSILLON STEEL MILL

permanently with the generator terminals without any control apparatus in series, the speed being regulated within the range of 0 r.p.m. to 47 r. p. m. by changing the generator-field excitation. The generator and reversing motor are separately excited from a motor-driven exciter set employed especially for this equipment so that operation is dependent only on continuity of the alternating-current supply and not on an excitation system common to all equipment in the mill.

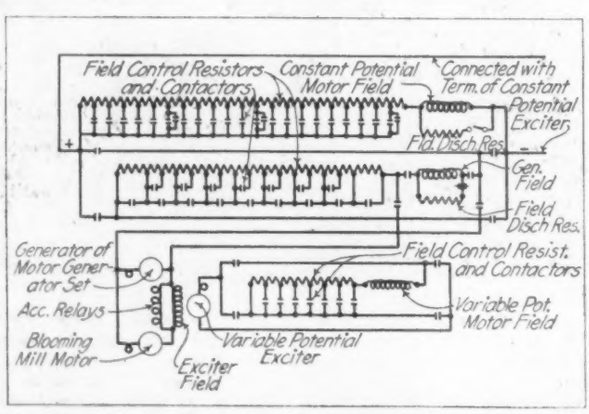
When an ingot approaches the blooming mill the motor is turned over slowly until the rolls grip the metal, then the speed is increased to about 47 r.p.m. to complete the roughing passes. During the finishing passes the motor speed is still further increased by weakening the motor field. Racing cannot occur when the motor is turning over idly before the metal enters the rolls, since the speed is practically independent of the load. This is a distinct advantage over operation with steam engines, since they usually race when operating without load or come to a standstill when the rolls grip the metal.

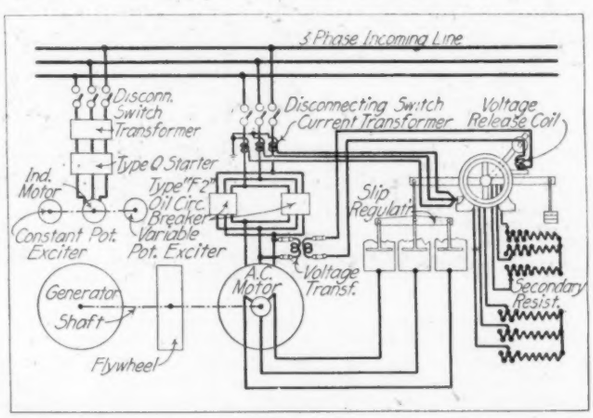
At the end of each pass the generator field is de-energized and the mill motor brought to rest by regeneration. During this period it "pumps" energy back into the flywheel generator set, thereby speeding it up preparatory to the gripping of the metal in the next pass. Approximately 70 per cent of the energy required to accelerate the rotating parts of the mill is regained in this manner. Reversal of the blooming-mill motor is accomplished by reversing the direction of shunt-field current through the generator, residual magnetism being killed by automatically actuated field-forcing relays. In this operation accelerating relays increase the motor torque by cutting in resistance to decrease the field current of the main motor, thereby increasing the current through the motor armature.

As shown by the diagram of Fig. 5, the slip of the induction motor-generator is controlled by automatically varying the resistance in the motor secondary by means of a slip regulator actuated by a current proportional to that delivered to the motor-generator. Thus, when the current to the latter tends to increase, the slip regulator increases the slip of the motor-generator, thereby permitting the flywheel to give up some of its kinetic energy. At the same time the increased current delivered to the blooming-mill main motor, by means of the connections shown, increases the excitation of the variable potential exciter, thereby improving the blooming-mill motor's torque. Attached to the same motor which drives the variable-potential exciter is a constant-potential exciter which supplies current to another field winding of the blooming-mill motor and the field of the generator.

Although the reversing motor develops peaks of 8000 hp., the input to the alternating-current motor does not exceed 1200 kw. In other words, the power taken from the generating station for this equipment does not exceed 1200 kw., consequently the central-station generating and boiler equipment to operate this mill need not exceed the rating required to generate a load of 1200 kw. Furthermore, the steam economies obtained under such conditions are considerably better than those obtained from operating a reversing engine directly from a boiler plant. The energy required per ton of metal rolled depends upon the size of the finished material, its chemical composition, etc. At this plant from 20 kw.-hr. to 30 kw.-hr. per ton is sufficient for rolling different grades of metal, including vanadium steels.

Data relating to the ratings of the blooming-mill motors and equipment employed in other parts of the mill are given in the accompanying table. The larger motors, such as are used for operating some of the





FIGS. 4 AND 5—GENERAL SCHEME OF EXCITING BLOOMING-MILL AND MOTOR-GENERATOR MOTORS TO HANDLE FLUCTUATING LOADS, AND SLIP REGULATOR WHICH COMPELS FLYWHEEL OF MOTOR-GENERATOR SET TO CARRY MOMENTARY PEAK LOADS

The slip regulator consists of three water rheostats, the movable plates in which are attached to one end of a counterbalanced lever whose fulcrum is the shaft of a wound-rotor induction motor. The primary of the regulator motor is energized by current transformers connected in series with the supply line to the motor-generator set so that increase of current therein will raise the movable electrodes of the rheostat. The slip of the motor-generator will then be increased and the flywheel permitted to give up some of its kinetic energy. The torque of the regulator motor may be adjusted by changing the secondary resistance. The no-voltage release coil compels the slip regulator to insert the maximum resistance in the secondary of the motor-generator motor when service is interrupted, so that excessive current will not be drawn from the line when the motor starts again.

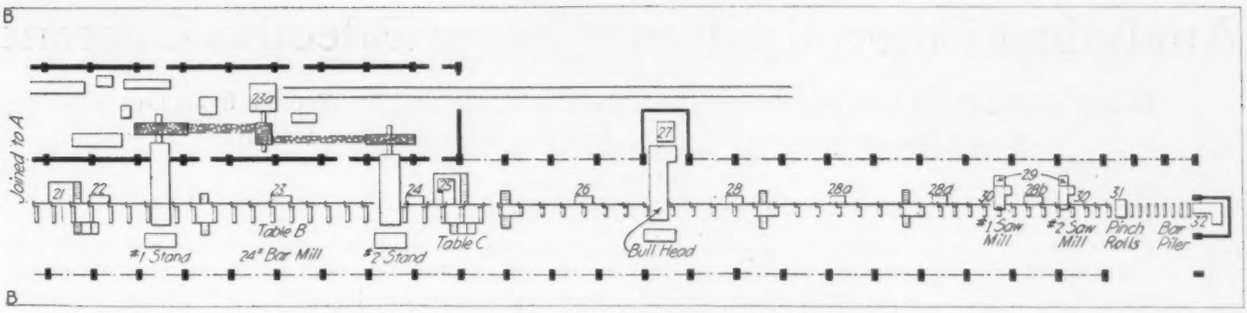


FIG. 6—BAR-MILL AND BULL-HEAD PORTION OF STEEL PLANT

blooming-mill accessories, bar mill, bullhead, air compressor and pumps, are designed for 2300-volt service, but the smaller units, except those in the machine shop, are operated on 250-volt direct current supplied by two 500-kw. rotary converters. The machine-shop motors

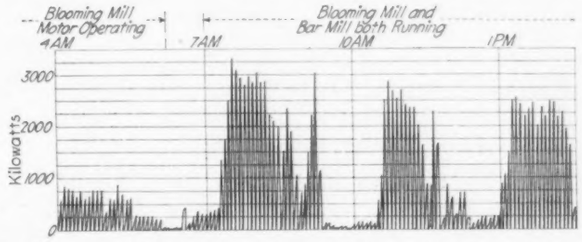


FIG. 7—FLUCTUATIONS IN BLOOMING-MILL AND BAR-MILL LOAD

and general mill-lighting circuits are energized by 300-kw., 2200/230-115-volt transformers.

The electric-service company agrees to deliver 2200 volts, three-phase, sixty-cycle energy, but variations in potential from 2100 volts to 2400 volts will not be considered objectionable by the steel company, according to its contract. All energy except such as the steel company may be able to generate by the use of exhaust steam or waste-heat boilers is to be purchased from the central-station company. It may be pointed out that the steel company's only present source of power supply except from the central station is a 1000-kw. low-pressure turbine. While, as already stated, 2000 kw. is the estimated demand on which the contract was based, an additional 1000 kw. will be available on fifteen minutes' notice. With four months' notice, the central-station company agrees to be ready to supply any amount of energy required by the steel company.

A sliding-scale demand and energy-charge rate is em-

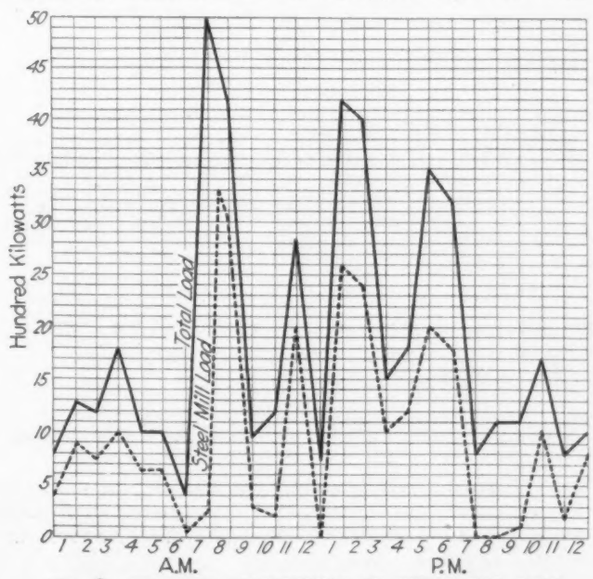


FIG. 8—RELATIVE PROPORTIONS OF STEEL-MILL LOAD

ployed, the demand being taken as the average of the five highest five-minute demand peaks as shown by a peak-demand meter for a period of one month. The average rate per kilowatt-hour has been guaranteed by the central-station company not to exceed a certain fixed

KEY TO DRAWINGS OF STEEL-MILL APPARATUS LAYOUT

Key No.	Application	Number of Motors	Type	Rating of Each
1	Soaking-pit cover operating mechanism[1]	4	230-volt d.c.	25 hp.
2	Blooming-mill rolls	1	750-volt d.c.[2]	670,000 ft.-lb. at 47 r.p.m.
3	Blooming-mill motor fans[3]	2	230-volt a.c.	15 hp.
4	Ingot approach table	1	230-volt d.c.	55 hp.
5	Ingot entering table	1	230-volt d.c.	90 hp.
5a	Ingot delivery table	1	230-volt d.c.	90 hp.
6	Roll separation adjuster	2	230-volt d.c.	80 hp.
7	Manipulators for directing ingots into proper pass	4	230-volt d.c.	80 hp.
8	Fingers for turning ingots[4]	1	230-volt d.c.	80 hp.
9	Shear-approach table	2	230-volt d.c.	55 hp.
10	Double-end exciter set[5]	1	2200-volt a.c.	50 hp.
11	Main motor-generator set[6]	1	2200-volt a.c.	1500 hp.
12	Rotary converters	2	178/250-volt	500 kw.
13	Slip regulator			
14	Six transformers		2200/178-volt	185 kva.
14a	Lighting transformer		2200/230/115-volt	300 kva.
15	Switchboard			
16	Shear[7]	1	2200 volt a.c.	150 hp.
17	Shear clutch	1	230-volt d.c.	5 hp.
18	Dipping table	1	230-volt d.c.	25 hp.
19	Shear-delivery table	1	230-volt d.c.	55 hp.
20	Bloom pusher	1	230-volt d.c.	55 hp.
21	Bar-mill manipulator	1	230-volt d.c.	25 hp.
22	Table A in bar mill	1	230-volt d.c.	80 hp.
23	Table B in bar mill	1	230-volt d.c.	80 hp.
23a	Bar-mill main motor	1	2200-volt a.c.[8]	1500 hp.
24	Table C in bar mill	1	230-volt d.c.	55 hp.
25	Bar-mill manipulator	1	230-volt d.c.	25 hp.
26	Bullhead-approach table	1	230-volt d.c	55 hp.
27	Bullhead main motor	1	2200-volt a.c.	800 hp.
28	Bullhead-delivery table	1	230-volt d.c.	55 hp.
28a	Saw-approach table	2	230-volt d.c.	55 hp.
28b	Saw table	1	230-volt d.c.	55 hp.
29	Hot saws	2	230-volt d.c.	50 hp.
30	Saw tilters	2	230-volt d.c.	25 hp.
31	Pinch rolls	1	230-volt d.c.	25 hp.
32	Bar piler	1	230-volt d.c.	25 hp.

[1]Permit inserting and removing ingot from gas-fired soaking pits. [2]Reversible. [3]Ventilate blooming-mill motor. [4]Arranged to give ingots quarter turn. [5]Consisting of a 25-kw., 125-volt direct-current constant-potential generator and a 10-kw. direct-current variable-potential generator. [6]Driving a 1950-kw., 750-volt direct-current generator with 30-ton flywheel. [7]Driven through reduction gears. [8]Non-reversible.

figure for certain portions of each year, provided that the steel mill does not operate during the central station's peak. Failure of the steel mill to observe this off-peak schedule nullifies the low-guarantee rate. A clause in the contract also requires the steel mill to give thirty days' notice in case more than 300 kw. is required during the central-station peak, but so far the clause has not been enforced. All switchboard instruments and lines are owned and maintained by the electric-service company, but the steel company provided the substation apparatus and right-of-way for lines.

During its period of development the Massillon Electric & Gas Company has been under the management of H. L. Doherty & Company. The local manager is T. O. Kennedy, the new-business manager is O. A. Acuff, and the general superintendent is A. V. Wynne.

Analytical Determination of Mean Effective Current

Convenient Means for Calculating the Size of a Motor and Its Feeder from Duty-Cycle Diagrams, and Formulas Used in Attaining the Results

BY W. D. PEASLEE
Consulting Engineer, Portland, Ore.

THE size of a motor or feeder for a particular duty is determined by the mean effective current of the duty cycle. It is laborious to derive this mean effective current from the curve of instantaneous values of current or power in the usual way by subdividing the area of the rectangular plot into small areas and from these determining the $\Sigma i^2 dt$. The problem is simplified by the introduction of polar co-ordinates. The method of transforming from rectangular to polar co-ordinates is shown in Fig. 2.

This method has been effectively used by the author

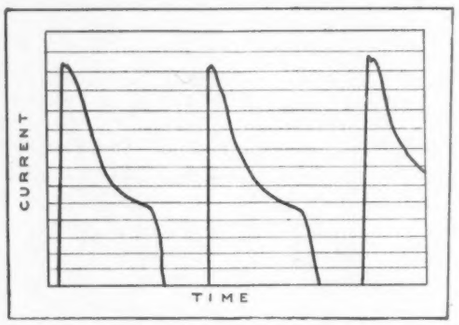


FIG. 1—CURVE OF INSTANTANEOUS VALUES OF CURRENT DRAWN BY HOIST MOTOR UNDER ITS DUTY CYCLE

in the determination of the mean effective current in a hoist motor under a given load cycle and is explained in what follows.

In Fig. 1 the curve of instantaneous values of current drawn by the hoist motor under its duty cycle is shown with time as abscissa with a scale of 1 in. representing one minute. The ordinates show current on a scale of 1 in. representing 20 amp. This curve was then transferred to polar co-ordinates by substituting angles for one of the axes of the rectangular curve. In this case 30 deg. represents one minute of time, the

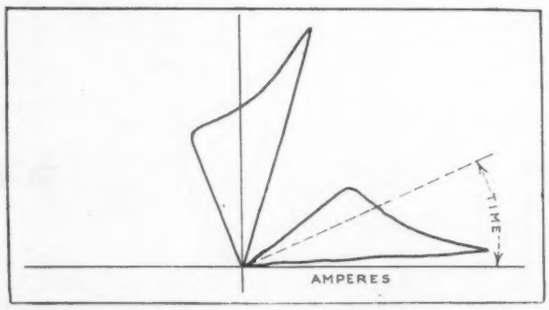


FIG. 2—CURRENT DRAWN BY HOIST MOTOR TRANSFORMED FROM RECTANGULAR TO POLAR CO-ORDINATES

ampere axis becoming the radius vector to the same scale as in the rectangular plot.

It is then required to find the radius at which one minute of time in the polar curve has an arc length of 1 in.; that is, the same scale as in the rectangular curve. From the time angular scale 30 deg. equals one minute, and 360 deg. equals twelve minutes, and the radius of a circle whose circumference is 12 in. is $12 \div 2\pi$, or 1.910. This constant is a fundamental link in the method and is designated C.

If a small sector of the polar curve in Fig. 3 is taken so that the values of current included are within differential limits equal, and dt is the differential increment of time as the current vector passes from 1 to 2, then at a radius $C = 1.910$ the length dt will represent time, as does the angle $d\theta$.

Since $d\theta$ is very small, the figure 0-1-2 may be taken within differential limits as a triangle, and its area then will be $\frac{1}{2}I \times$ arc 1-2. However, the arc 1-2 will be seen equal to $dtI \div C$, so that we have:

$$\text{Area} = \tfrac{1}{2} I \frac{dtI}{C} = \frac{I^2 dt}{2C}.$$

The whole area of the load curve will then be $\Sigma I^2 dt \div 2C$, or in more convenient form we can write:

$$\Sigma I^2 dt = \text{area} \times 2C.$$

Therefore, the area of the curve when multiplied by a constant gives the sum of the squares of the different instantaneous values of current multiplied by the time during which it flows, and this leads at once to the mean effective current.

The mean continuous current that will give the same heating effect as the given load current is, then,

$$I_e = \sqrt{\frac{\Sigma I^2 dt}{T}}$$

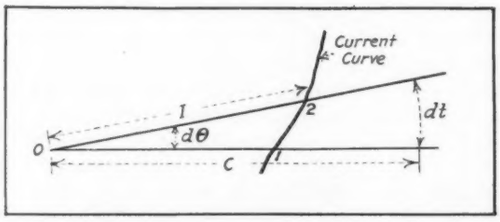


FIG. 3—A SMALL SECTOR OF THE POLAR CURVE OF FIG. 2 REFERRED TO IN DERIVING FORMULA FOR MEAN EFFECTIVE CURRENT

where T is the total time for which the heating effect is desired.

From this we have at once:

$$I_e = \sqrt{\frac{\text{area} \times 2C}{T}}.$$

Since the area is readily obtainable by means of a planimeter, the solution is simple.

Thus in the case of the hoist motor referred to the area by planimeter over a ten-minute cycle was found to be 231.4 sq. in.

$$\text{Area} \times 2C = (231.4 \times 2 \times 1.910) = 884.0.$$

Then, taking account of the scales used, we have:

$$\Sigma I^2 dt = 884 \times 20^2 \times 60 = 2{,}121{,}600.$$

Then

$$I_e = \sqrt{\frac{\Sigma I^2 dt}{T}} = \sqrt{\frac{2{,}121{,}600}{10 \times 60}} = \sqrt{3536} = 59.4 \text{ amp.}$$

The method as shown is easy to use and very simple, and will prove valuable to anyone encountering problems involving the determination of mean effective current for any duty cycle.

Milwaukee's Extensive Street-Lighting Plan

Features of Experimental Installation Made to Determine the Advisability of Adopting City-Wide Changes in Street Illumination

MILWAUKEE has just completed a thirty-four-thousand-dollar demonstration installation of a purely scientific street-lighting system comprising 176 gas and electric lamp-posts. The completed system as proposed will displace all present equipment without any attempt to utilize existing posts, lamps or distribution cables and will call for the installation of about 6800 electric lamp-posts. The demonstration installation, portions of which are illustrated herewith, has been made to afford the citizens of Milwaukee an opportunity of judging by observation whether they will sanction a bond issue covering a city-wide installation of similar character. The layout and types of equipment which will be used have been adopted after a most exhaustive study by the illuminating engineering firm of Vaughn, Meyer & Sweet, Milwaukee. Practically every phase of the new system is an innovation in the street-lighting art. Adopting, as it has, a new system of energy supply, a new type of post, fixture and refractor, new standards of spacing and height of lamps, a new method of hanging center-suspension lamps, a 6.6-amp. system without constant-current transformers, entirely new adaptations of former construction methods and standard equipment, and other departures from all precedents in street-lighting practice, Milwaukee furnishes an instructive example of efficiently, attractively and scientifically illuminated streets.

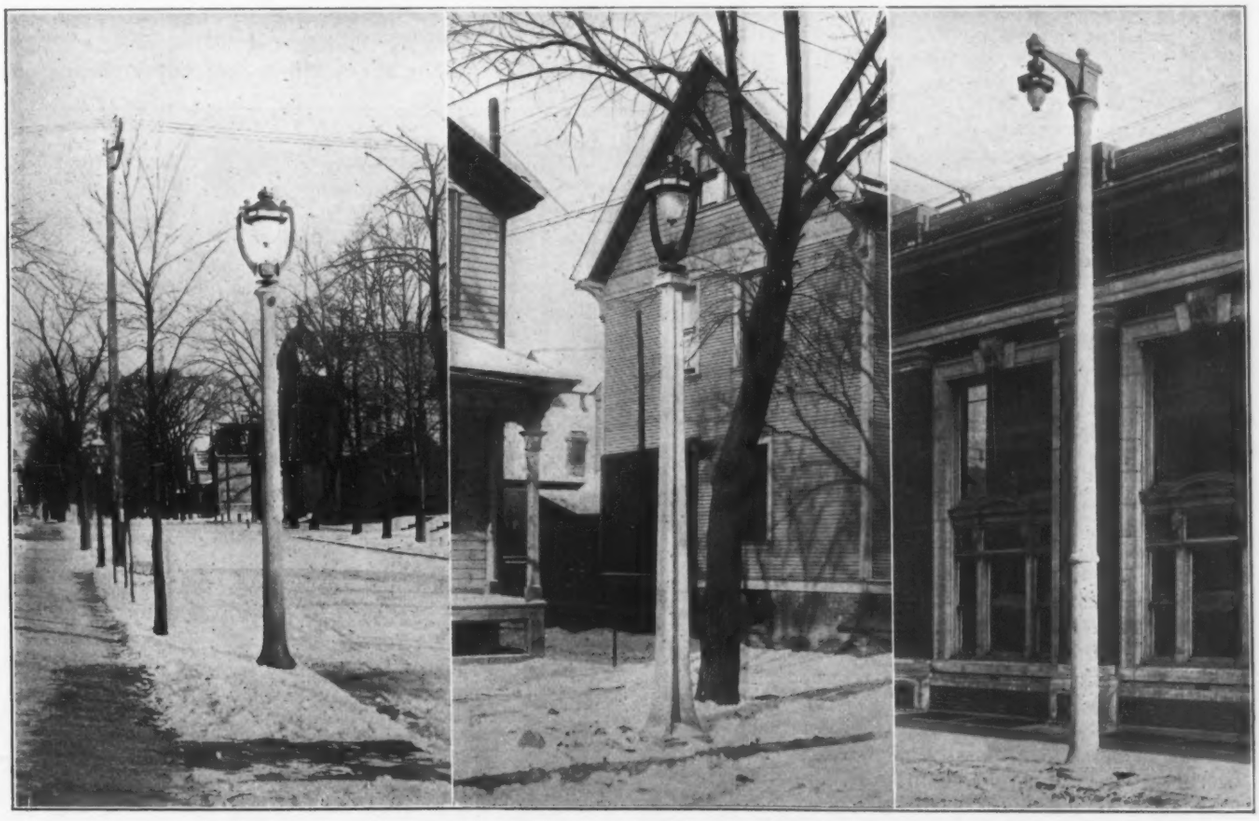
Except in extreme outlying districts, where the circuits will be overhead, practically the entire new street-lighting equipment will be energized from a 6.6-amp. underground system. Similarly shaped concrete poles, differing only in lamp-mounting height, will be employed except where center-suspension units are required, and all light sources will be inclosed in uniformly designed fixtures equipped with refractors. In determining the method of distribution and types and arrangement of equipment that would be most suitable for Milwaukee the illuminating engineers investigated the character of the streets and the uses made of them. In this study arrangements of units which would minimize collisions and discourage burglaries or robberies on the streets illuminated were given special consideration. As a result of the foregoing considerations, it was decided that there were five different classes of districts, requiring as many different intensities of illumination, lamp supports, spacings and mounting heights. The intensities of illumination which were selected for the different sections are tabulated below:

Section	Ft.-Candles
Outskirts	0.01
Residence	0.03
Subsidiary traffic feeders*	0.06
Main traffic thoroughfares	0.12
Promenades or boulevards	0.50

*Transitory districts, i.e., residence sections which are changing into business districts.

HEIGHT AND SPACING OF UNITS

On account of the shadows cast by the foliage of trees and the impracticability of installing the lighting units among branches, the shade trees were perhaps the chief obstacle with which the engineers had to cope in



TYPICAL TYPES OF LAMP SUPPORTS IN RESIDENTIAL AND SEMI-BUSINESS DISTRICTS

DOUBLE-BRACKET FIXTURES ON GRAND AVENUE

deciding on the height, spacing, location and type of unit. An effort was made, however, to place the units as high as was feasible under this restriction and that of building height and economical considerations, in order that the glare and blinding effect might be reduced to the minimum. Taking these things into consideration, a suspension-type unit was adopted for use at street intersections in residential sections and a 15-ft. concrete post-type unit with a fixture in the form of a harp supporting a single lamp was selected for intermediate points along the block. For the small-business districts where both business houses and residences exist a 22.5 ft. concrete-post unit with single or double bracket arm was adopted in some instances, and in others the suspension-type unit was used at both street intersections and at intermediate points in the block. For the main business district a high concrete-post unit was adopted, with the requisite number of brackets supporting lamps 30 ft. above the street. To obtain uniform illumination in parks and public squares, make the

TABLE I—SUMMARY OF UNITS AND LAMPS ON DEMONSTRATION CIRCUIT

Number of Units	Type	Number of Lamps	Candlepower	
41	Center suspension units, electric	41		400
52	22½-ft. single-bracket-post units, electric	52	Ten Forty-two	600 400
22	15-ft. harp-post units, gas	22		
45	15-ft. harp-post units, electric	45	Thirty-two Thirteen	250 100
16	30-ft. double-bracket-post units, electric	32		1000
176		192		

source of light unobjectionable as regards eye comfort, and still emphasize the location of parks from a distance, multiple-bracket concrete-pole units were adopted with the lamps placed 45 ft. high. It may be pointed out that the different standard heights adopted were selected with the definite ratio of 1:1.5:2:3 to facilitate the adjustment of relations between spacings and mounting heights.

For the down-town districts on Grand Avenue the ratio between spacing and mounting height was made 6:1, making the separation 120 ft., whereas, in the residence districts a ratio of 12:1 was chosen, giving a spacing of 180 ft. An intermediate ratio of 8:1, also giving a spacing of 120 ft., was considered advisable on forested streets. Uniformity of illumination was the governing factor in selecting these ratios.

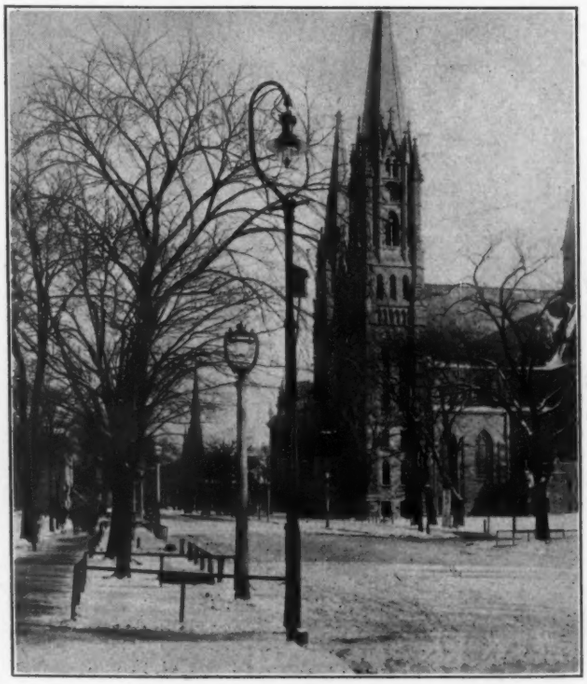
To facilitate planning the details of the installation maps were used on which were designated the amounts of light required in lumens per running foot for various streets, the aforementioned mounting heights and ratios between spacing and height. With this information and a formula (length of block in feet multiplied by lumens per running foot required divided by the number of units to be installed per block equals the size in lumens of the lamp to be installed) the size of the

TABLE II—NUMBER OF UNITS AND NUMBER OF LAMPS FOR RECOMMENDED SYSTEM

Number	Item
Units:	
2022	15 -ft. concrete-post units, gas
1430	15 -ft. concrete-post units, electric
2490	22½-ft. suspension units, electric
1924	22½-ft. concrete-post units, single-bracket, electric
142	22½-ft. concrete-post units, double-bracket, electric
429	30 -ft. concrete-post units, single-bracket, electric
362	30 ft. concrete post nuits, double-bracket, electric
10	45 -ft. concrete post units, double-bracket, electric
3	45 -ft. concrete post units, double-bracket, electric
8821	Total number of units
Lamps:	
2022	100-cp. lamps, gas
1015	100-cp. lamps, electric
881	250-cp. lamps
3328	400-cp. lamps
1359	6000-cp. lamps
739	1000-cp. lamps
2022	Total number of gas lamps
7322	Total number electric lamps
9344	Complete total lamps

lamp required was computed. The units were then spotted on the maps and posts were actually placed as close to these points as possible, due consideration being given to installing them on lot lines between houses as far as practicable.

An effort was also made in locating the units to secure adequate lighting for the alleys, and wherever proper illumination of the streets would not be sacrificed by so doing they were placed at the heads of the alleys. However, in this recommended street-lighting system it is not considered that the alleys are sufficiently cared for, and a future plan is contemplated whereby, after the city has thoroughly illuminated its streets, adequate illumination of the alleys will be secured by placing ad-



RESIDENCE-TYPE FIXTURE WITH OLDER TYPE LAMP-POST IN FOREGROUND

ditional units at the alley intersections in the interior of the blocks where the present plan does not cover the case.

Although all of the posts for the ultimate system will not be installed this year, a uniform spacing of poles has been laid out for each district, so that at a later

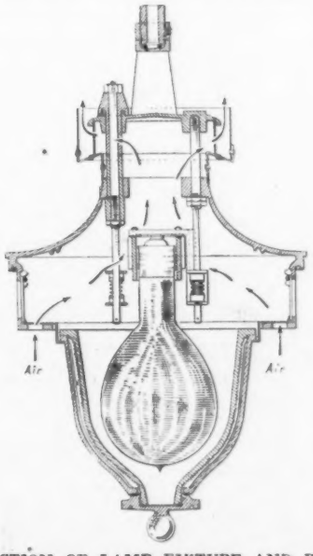
TABLE III—COMPARISON OF PRESENT MILWAUKEE STREET LIGHTING WITH STREET LIGHTING PROPOSED UNDER NEW SYSTEM

Present Units			Proposed Units				Candle-power Comparison	
			Check-Off		Additional			
Number	Type	Incandescent Equivalent, Cp.	No.	Size, Cp.	No.	Size, Cp.	Present System, Cp.	New System, Cp.
271	Gasoline	60	271	100	....	....	16,260	27,100
2766	Gas	60	2766	100	....	....	165,960	276,600
391	Gas	60	391	250	....	....	23,460	97,750
372	Inc. arc	250	372	250	....	....	93,000	93,000
922	Inc. arc	250	922	400	....	....	230,500	368,800
935	Open arc	400	935	400	1433	400	374,000	947,200
.....	.....	.....	.....	.....	59	500	53,400	29,500
89	Lum. arc	600	89	600	998	600	.....	652,200
.....	.....	.....	.....	.....	19	800	.....	15,200
.....	.....	.....	.....	.....	127	1000	.....	127,000
.....	.....	.....	.....	.....	80	1200	.....	96,000
.....	.....	.....	.....	.....	108	1600	.....	172,800
.....	.....	.....	.....	.....	248	2000	.....	496,000
.....	.....	.....	.....	.....	1	2400	.....	2,400
.....	.....	.....	.....	.....	2	4000	.....	8,000
Total..	.....	.....	.....	.....	3075	.....	956,580	3,409,550

date, when additional units are installed, they will be placed at predetermined points on the circuit. Also, when merchants desire to increase the lighting intensity in front of their stores, they can do so by simply petitioning for larger lamps and paying for the increase in energy cost. No additional posts and no design different from the adopted standard will be allowed, however.

Method of Mounting Lamps

The concrete lamp-posts which will be adopted for practically the entire system will probably be of a type made by a centrifugal process and reinforced with 6 sq.



CONSTRUCTION OF LAMP FIXTURE AND REFRACTOR

in. of steel. Each is provided with a concrete base which is grouted into a cylindrical mold. A steel conduit extends through the center of each pole and projects from the top so that either the single-bracket or double-bracket fixture or the single-lamp harp supports may be attached thereto and interchanged when desired. This method of making poles is a development of the

CENTER-SUSPENSION UNIT WHICH SUPERSEDES BRACKET CONSTRUCTION SHOWN

Universal Concrete Products Company of Milwaukee.

To support the standard suspension units employed at street intersections in the residence districts on the demonstration circuit, two tubular steel poles placed at diagonally opposite corners are used with a steel messenger suspension wire strung tightly between them. The unit is permanently suspended at the center of the span wire 22½ ft. above the ground. This type and all other units are to be maintained by the use of specially designed extensible tower wagons similar to those used in Philadelphia and New York for this purpose.

TABLE IV—COMPARISON OF PER CAPITA INVESTMENTS IN STREET-LIGHTING SYSTEMS IN CITIES OF FROM 300,000 TO 600,000 POPULATION

City	Population	Investment	Per Capita
Baltimore	584,605	$571,190	$0.98
Pittsburgh	571,984	527,817	0.92
Los Angeles	475,367	434,454	0.92
Buffalo	461,335	497,190	1.08
San Francisco	456,009	435,000	0.95
Milwaukee	428,062	232,910	0.54
Cincinnati	406,706	399,422	0.98
Newark	399,000	267,030	0.67
Washington	358,679	380,225	1.06
Minneapolis	353,460	312,193	0.88
Jersey City	300,133	164,607	0.55
Average	.....	.....	0.87

Although tubular steel poles were used in the demonstration installation to carry all center-suspension units, it is anticipated that a concrete pole will be developed shortly for use at these locations, thereby making the ultimate street-lighting system a complete concrete-post installation. The steel poles used in the demonstration circuit were manufactured by the Line Materials Company of South Milwaukee and are oxy-acetylene welded at the joints. The Chicago Concrete Post Company furnished twelve concrete posts for the demonstration circuit.

Design of Fixtures and Refractors

Owing to the engineering requirements, height of light sources above the streets and the limitations of the physical sizes of the refractor and lamp, together with artistic requirements controlled by the different characteristics and uses of the street and the absence on the market of any fixtures which adequately met all the requirements, it was necessary to devise new types of fixtures for the different districts and streets. To this end valuable assistance was given the illuminating engineers by a committee of architects appointed by the local chapter of the American Institute of Architects. The fixture which was developed comprises a ventilated base, which serves to dissipate the heat generated by gas-filled lamps or will permit the entrance of air if

gas lamps are used; facilities for permitting the lamp to be raised or lowered in the refractor to change distribution of light, and a bug screen and reflector.

One of these fixtures equipped with a refractor developed in co-operation with the Holophane Company is shown in an accompanying drawing. The curves of light

TABLE V—ESTIMATED ANNUAL MAINTENANCE EXPENSE PER LAMP

Lamp	Maintenance Cost per Lamp
100 cp.	$10.08
250 cp.	11.88
400 cp.	14.64
600 cp.	17.14
1000 cp.	19.68

distribution from one of these units equipped with an electric incandescent or gas lamp are said to approximate the prototype curves more closely than those of any other unit available. Furthermore, the distribution can be conveniently varied by raising or lowering the lamp slightly in the refractor, thereby making it possible to direct the maximum-intensity rays where desired.

This refractor consists of two telescoping bowl-shaped pieces of glassware, one with horizontal prisms on the outside and the other with vertical prisms on the inside, assembled in a dust-proof manner so that the smooth glass surfaces of the two form the outside and inside surfaces of the bell, thus making it easy to clean.

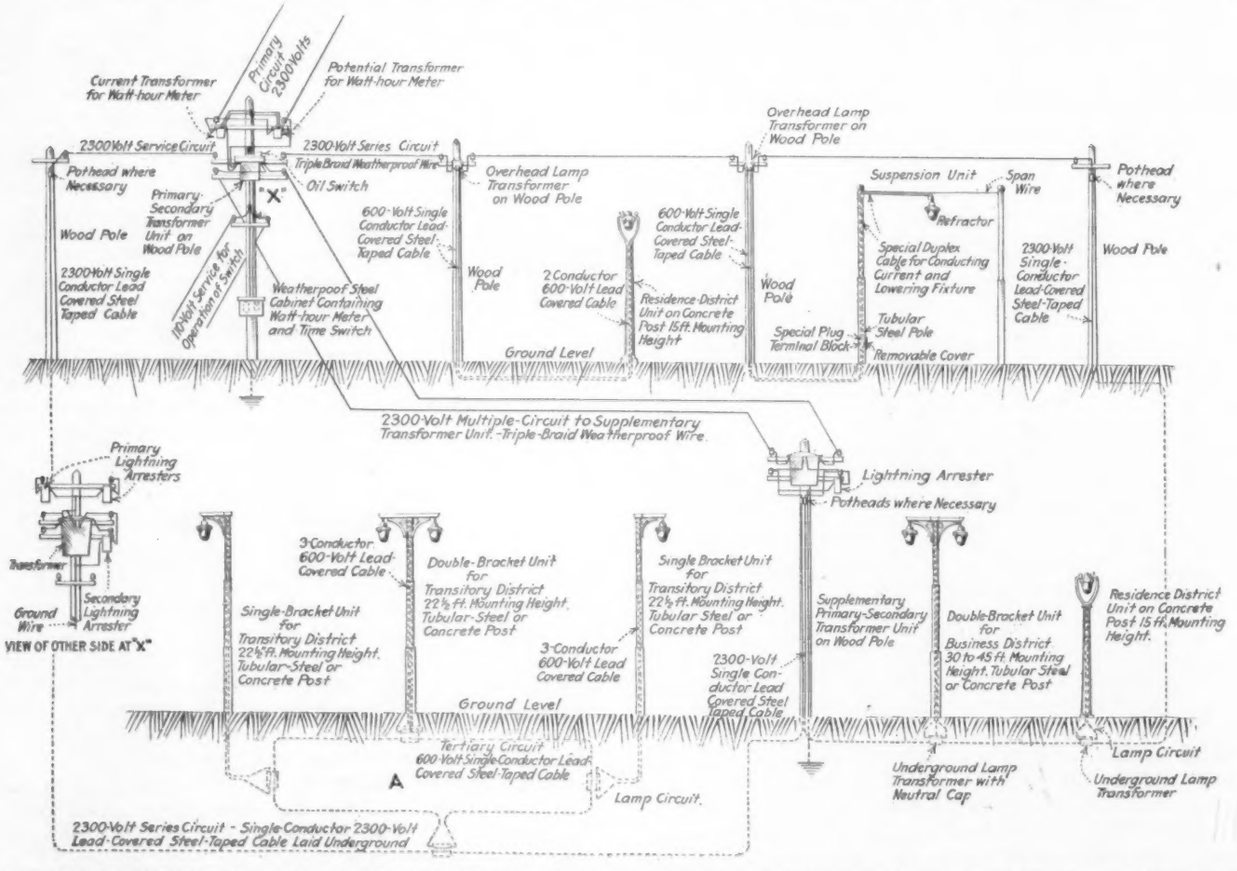
Gas lamps have been recommended for certain intermediate points the long way of the block where the interest charges on the investment in cable saved is sufficient to offset the increased cost of operation by gas. A gas lamp may be substituted for the electric lamp in any of the 15-ft. post fixtures without any alteration in the fixture. Twenty-two gas lamps were installed on the demonstration circuit, and 2022 are recommended for the entire installation.

COST DATA AND MAINTENANCE CHARGES

The total cost of the recommended installation is placed at $1,329,896. This is estimated to cover the installation of 8821 lighting units. The average cost is $176.56 per electric unit, while the average cost including both gas and electric equipment is $150.76 per unit. It has been estimated that with the total installation the annual energy charge, based on a rate of 1 cent per kilowatt-hour, will be $97,164.12, the maintenance charge will be $131,686.58, and the interest on the investment $102,414.93, making a total annual cost for the recommended system of $331,265.65. This maintenance figure was based on the unit charges given in an accompanying table and included lamp renewals, renewal of fixture parts, line repairs and trouble service, labor of lamp renewals, cleaning of light units, inspection for burn-outs, maintenance of candle-power and lamp quality, laboratory service, etc. In making this estimate it was assumed that each lamp would burn 4000 hours a year, with three renewals, twelve cleanings and 365 inspections in the same period.

The cost of the concrete posts used on the demonstration circuit was practically $1 a linear foot including the bracket, but it is expected that a somewhat more attractive price will be obtained when posts are ordered in large quantities for the complete circuit. The 15-ft. post was purchased for $15, the 30-ft. post for $36, and the 22½-ft. post for $25. None of the 45-ft. posts have been used yet, however.

The portion of the street-lighting system which has been completed was installed by the Langstadt & Meyer Construction & Supply Company, Appleton, Wis.


Primary Circuit 2300 Volts
Current Transformer for Watt-hour Meter
Potential Transformer for Watt-hour Meter
2300-Volt Service Circuit
2300-Volt Series Circuit
Triple Braid Weatherproof Wire
Oil Switch
"X"
Pothead where Necessary
Primary-Secondary Transformer Unit on Wood Pole
Wood Pole
2300-Volt Single Conductor Lead Covered Steel Taped Cable
110-Volt Service for Operation of Switch
Weatherproof Steel Cabinet Containing Watt-hour Meter and Time Switch
Overhead Lamp Transformer on Wood Pole
600-Volt Single Conductor Lead-Covered Steel-Taped Cable
2 Conductor 600-Volt Lead Covered Cable
Residence-District Unit on Concrete Post 15 ft. Mounting Height
Ground Level
Overhead Lamp Transformer on Wood Pole
Suspension Unit
Span Wire
Pothead where Necessary
Refractor
Special Duplex Cable for Conducting Current and Lowering Fixture
2300-Volt Single-Conductor Lead-Covered Steel-Taped Cable
Wood Pole
Special Plug Terminal Block
Tubular Steel Pole
Removable Cover
2300-Volt Multiple-Circuit to Supplementary Transformer Unit.-Triple-Braid Weatherproof Wire.
Primary Lightning Arresters
Lightning Arrester
Potheads where Necessary
Transformer
Ground Wire
Secondary Lightning Arrester
VIEW OF OTHER SIDE AT "X"
3-Conductor 600-Volt Lead-Covered Cable
Double-Bracket Unit for Transitory District 22½ ft. Mounting Height. Tubular-Steel or Concrete Post
Single-Bracket Unit for Transitory District 22½ ft. Mounting Height. Tubular-Steel or Concrete Post
3-Conductor 600-Volt Lead Covered Cable
Single Bracket Unit for Transitory District 22½ ft. Mounting Height. Tubular Steel or Concrete Post
2300-Volt Single Conductor Lead Covered Steel Taped Cable
Supplementary Primary-Secondary Transformer Unit on Wood Pole
Double-Bracket Unit for Business District 30 to 45 ft. Mounting Height. Tubular Steel or Concrete Post
Residence District Unit on Concrete Post 15 ft. Mounting Height.
Ground Level
Tertiary Circuit 600-Volt Single-Conductor Lead-Covered Steel-Taped Cable
A
Lamp Circuit.
Underground Lamp Transformer with Neutral Cap
Lamp Circuit
Underground Lamp Transformer
2300-Volt Series Circuit - Single-Conductor 2300-Volt Lead-Covered Steel-Taped Cable Laid Underground

METHODS OF CONNECTING LAMPS WITH UNDERGROUND AND OVERHEAD SERIES TRANSFORMERS WHICH ELIMINATE NECESSITY OF CONSTANT-CURRENT TRANSFORMERS

A Source of Error When Using the Sphere Gap

Investigations Which Show Variations in Spark-Over Voltage of a Sphere-Gap Setting, and Tests to Determine the Effect of Foreign Matter on Spheres

BY R. H. MARVIN

SINCE the sphere gap is now the standard for the measurement of high voltages in insulation testing adopted by the American Institute of Electrical Engineers, it is important to understand any possible causes of error in its use and how they may be avoided. The following details of a very puzzling irregularity in its action and concerning an investigation of its cause and prevention are of interest.

Up to last summer the writer had been using in test work a sphere gap 25 cm. in diameter. This was very satisfactory, and although the irregularity to be described existed, it was not of such magnitude as to attract serious attention. The error was discovered when a larger gap was required, a sphere gap 50 cm. in diameter being used. This was set up in a different part of the testing room from the old gap. While great care was taken to set it up and connect it according to the A. I. E. E. rules, on trying it out it was found to be hopelessly erratic in its behavior. The gap not only broke down at far too low a voltage as given by the transformer ratio, but its spark-over voltage varied. It may be mentioned here that the high-tension voltage with this transformer was obtained by ratio from a voltmeter supplied from a potential transformer connected to the low-tension winding. The ratio of the testing transformer could be varied by putting the two halves of the low-tension winding in series or multiple. The ratio of the potential transformer could also be varied. In all tests to be described the middle of the high-tension winding was grounded. The frequency was sixty cycles. Table I gives the voltmeter readings in the order in which they were taken, also the voltmeter readings expressed as percentages of what it is now known would have been about the correct reading.

These results were obviously in error. The trouble was at first thought to be due to surges set up by too large steps in the field boxes. The voltage was regulated by rheostats in the alternator and exciter fields.

TABLE I—VOLTMETER READINGS FOR DIFFERENT GAP SETTINGS

Gap Setting		Voltmeter Reading		
Kv.	Millimeters	Actual Value	Value in Percentage of Probable Correct Value	Kv. by Ratio
100	51	49	57	49
100	51	56	65	56
100	51	49	57	49
150	78	90	70	90
150	78	88	68	80
350	212	80	53	160
350	212	81	54	162
350	212	80	53	160
270	151	66	57	132
270	151	71	61	142
270	151	71	61	142

This is undoubtedly a source of error, but at the present time it appears probable that only a small part of the trouble was due to this. Finally, after some further experimenting, a water resistance was provided in the exciter field. By using this the readings given in Table II were taken. The tests were started with the 300-kv. gap setting. The first voltmeter reading is given at the top of the column, with others following. The 400-kv. setting was next tested, and so on. The first column for each gap setting gives the actual voltmeter reading and the second the voltmeter reading as a percentage of the highest reading in the column. The readings were taken consecutively, and at intervals ranging from half a minute to several minutes in some cases.

Two features are noticeable in Table II. The first is that in each column the readings are low and irregular at first, becoming gradually higher and more uniform. The second is that the first series of observations, that for 300 kv., shows the greatest irregularities; the next, for 400 kv., less, and the last observations, for 200 kv., the least of all. Subsequent tests have always shown the same general characteristics, so that on first using the gap it is necessary to take a large number of preliminary readings.

TABLE II—READINGS FOR SPHERE-GAP SETTINGS WITH ARRANGEMENT TO PREVENT SURGES

300 Kv., 171 Mm.		400 Kv., 256 Mm.		200 Kv., 106 Mm.	
Actual Reading	Per Cent	Actual Reading	Per Cent	Actual Reading	Per Cent
88	71.5	82.0	97.0	76.0	90.5
82	66.6	77.0	91.2	73.0	87.0
110	89.4	81.0	95.8	84.0	100.0
108	87.8	76.0	90.0	83.0	98.9
112	91.0	79.0	93.4	84.0	100.0
96	78.0	80.5	95.3	83.0	98.9
116	94.3	80.0	94.6	83.5	99.4
117	95.0	80.5	95.3	82.5	99.4
120	97.5	81.0	95.8	83.0	98.9
119	96.8	82.0	97.0	.....	.....
117	95.0	*	*	.....	.....
122	99.2	84.0	99.4	.....	.....
120	97.5	84.0	99.4	.....	.....
122	99.2	84.5	100.0	.....	.....
122	99.2	75.0	88.7	.....	.....
123	100.0	84.0	99.4	.....	.....
122	99.2	83.5	98.8	.....	.....
122	99.2	83.5	98.8	.....	.....

* Twelve readings omitted here.

This relation between the spark voltage and the number of times the gap has recently been arced over eliminates at once the idea of the low readings being due to surges or other disturbances in the circuit and naturally leads one to suspect that it has some connection with the condition of the surface of the spheres. The fact that the disturbing cause was gradually removed during the tests mentioned suggested that there might be some foreign substance on the spheres which was dissipated by the heat of the arc. The writer first thought that the irregularity must be due to a film of water condensed from the air. If this were so, the trouble might be prevented by first coating the spheres with a thin layer of some insulating oil or grease. Later on, in the course of the investigation, it was suggested by an associate, J. S. Lawson, that the cause of the trouble might be dust or else particles of lint from the cloth used in wiping the spheres. To investigate all these points, the following experiments were made.

EXPERIMENTS TO DETERMINE CAUSE OF DIFFERENCES IN READINGS

On account of its convenience for experimental work, the sphere gap of 25 cm. diameter previously mentioned was used. It had been removed to another loca-

tion and set up for use with a 300,000-volt, sixty-cycle transformer. This transformer was operated from the city lines, the voltage being varied by an induction regulator. The voltage was read by a voltmeter connected to a voltmeter coil on the transformer core. The middle of the transformer was grounded. Water resistances were used on both sides of the gap. The investigation consisted in first finding the permanent reading with the gap in its usual condition and then applying substances to the surface of each sphere. In applying water or other substance to the spheres it was not spread over the entire surface but only within a radius of a few inches from the axis of the spheres. In all experiments the gap was set at 123 mm. or 200 kv. As we are interested only in the ratio of the voltmeter readings, the meter reading at spark-over when the spheres were in the dry, permanent condition is assumed as the base and other readings expressed as percentages.

In all cases a number of readings were taken after applying the material, and it was found that with all the substances which lowered the spark voltage the effect decreased with sucessive discharges, the arc appearing to remove the material. This is the same result as was previously noticed in the regular use of the gap. The room where the tests were made was rather warm and dry, and it was found that the water on the spheres would dry off in about five minutes and the spark voltage would become normal. This also accounts for the fact that the film of moisture left by breathing

TABLE III—RESULTS OF EXPERIMENTS TO DETERMINE EFFECT OF CONDITION OF SPHERE SURFACE

Experiment Number	Condition of Surface of Spheres	Number of Trials	First Voltmeter Reading, per Cent	
			Range	Average
1	Spheres moistened by breathing on them	4	99–100	100
2	Water applied with wet cloth; minute drops visible on surface	9	46–75	62
3	Water applied with damp cloth; no water visible	1	82	82
4	Water applied with atomizer; minute drops visible on surface	3	56–65	62
5	Gasoline applied with cloth	2	99–100	100
6	Transil oil applied with cloth; visible film of oil	6	100–103	102
7	Transil oil applied with cloth; no oil visible	5	96–100	98
8	Vaseline applied with cloth; visible film of vaseline	3	100–102	101
9	Water applied with wet cloth, then spheres wiped with dry cloth	2	91–95	93
10	Water applied with wet cloth, then spheres wiped with cloth soaked in gasoline	3	95–100	98
11	Water applied with wet cloth, then spheres wiped with cloth soaked in transil oil, leaving visible film of oil	4	78–101	95
12	Water applied with wet cloth, then spheres wiped with cloth soaked in transil oil; no visible film of oil left	6	93–101	98
13	Water applied with wet cloth, then spheres wiped with cloth soaked in vaseline, leaving visible film of vaseline	2	57–59	58
14	Transil oil applied with cloth, then spheres wiped with dry cloth	7	94–101	97
15	Cotton lint scrapped from dry cloth and allowed to fall on lower sphere	3	71–85	78
16	Cotton lint (experiment No. 15) wiped off with cloth soaked in transil oil, leaving no visible film of oil	1	100	100
17	Dry dust and shavings from floor thrown against spheres, leaving small particles adhering	2	66–68	67
18	Dust (experiment No. 17) wiped off with cloth soaked in transil oil, leaving no visible film of oil	2	98–100	99

on the spheres caused no noticeable error, as it could be seen to disappear at once. The transil oil used in these tests was No. 8 transil oil, obtained from the General Electric Company; however, it is probable that any other insulating oil would act in the same way. To insure that the action of the oil was not due to any unusual insulating qualities, the oil was taken from a quantity which had been used for puncture tests and had also been exposed to the air for a long time. The vaseline was the common yellow vaseline.

Results of Experiments

These experiments bring out a number of interesting facts. They show that water or small particles of even poor conductors, such as lint and dust, will reduce the spark voltage to from 80 to 60 per cent of its normal value. This is more curious when we consider that it would be equivalent in this case to reducing the gap length by 1¼ in. to 2¼ in. It was thought possible that the action when the water was applied with a cloth was really due to the particles of lint. Experiment No. 4 was therefore made, the water being applied with an atomizer to avoid this possibility. The results were unchanged, showing that water alone can cause the reduction.

TABLE IV—READINGS OF SPHERE-GAP SETTING AFTER SPHERES HAD BEEN WIPED WITH OILY CLOTH

350 Kv., 212 Mm.		250 Kv., 137 Mm.		150 Kv., 78 Mm.		70 Kv., 35 Mm.	
Actual Reading	Per Cent	Actual Reading	Per Cent	Actual Reading	Per Cent	Actual Reading	Per Cent
71	94.6	104.0	98.2	66.0	100.0	65.0	100.0
72	96.0	106.0	100.0	65.5	99.3	64.5	99.3
75	100.0	105.5	99.5	65.0	98.5	64.5	99.3
75	100.0	105.5	99.5	.....	.....	.....	.....
74	98.6	.....	.....	.....	.....	.....	.....
74	98.6	.....	.....	.....	.....	.....	.....
75	100.0	.....	.....	.....	.....	.....	.....

Insulating substances applied to the spheres appear to have an effect dependent upon the thickness of the film. Gasoline is so volatile that it disappears almost as soon as applied. With both transil oil and vaseline the presence of a visible film produces a small but appreciable increase in the spark voltage. An invisible film of oil appears to have a negligible effect.

For cleaning the surface of the spheres either oil or gasoline appears to be satisfactory, the oil being most convenient to use. Vaseline showed distinctly poor results. A comparison between experiments Nos. 11 and 12 would appear to contradict the conclusion of the last paragraph, but the low average in experiment No. 11 is due to the single low reading of 78 per cent, caused possibly by insufficient care in cleaning the spheres. Wiping off the water with a dry cloth and also wiping off the oil with a dry cloth are unsatisfactory, owing probably to the particles of lint left behind.

The best method of cleaning the spheres appears to be to wipe them with a cloth containing merely sufficient oil to make it feel slightly greasy. This was tried on the sphere gap of 50-cm. diameter, with which the trouble was first noticed, with the results in Table IV.

It seems most reasonable to suppose that the trouble with the 50-cm. sphere gap was due to dust and lint rather than moisture, since it was used in a dry and somewhat dusty room. Just why it should have shown more serious irregularities than the 25-cm. sphere gap is still uncertain. It may be due to a different location and to dust falling from above, and there is the possibility, which has not yet been investigated, that the error due to moisture and dust increases with the size of the spheres.

The writer is not at present prepared to hazard any theory for the phenomena outlined and has attempted only to show the general nature of this source of error and to point out simple methods for its elimination.

Operation of Interpole Direct-Current Machines—II

An Analysis of Best Commutation Under the Brushes and a Study of the Action of Interpoles by Brush-Potential Curves

BY JUSTIN LEBOVICI

IN the first section of this article, which was published in last week's issue, several methods for locating the correct neutral position for brushes were discussed. The shape of the field curve in the neutral zone is rather flat, as can be seen from Fig. 7, which has been obtained on a four-pole interpole machine having an equal number of main poles and interpoles. The curves have been taken by driving the armature in a clockwise and counter-clockwise direction of rotation. The neutral zone, as shown by the millivoltmeter and two points spaced ⅛ in. apart, is not the same for both directions of rotation. If the machine under consideration is a reversing motor, it will be well to determine the neutral for both directions by methods already described and set the brushes between the two neutrals found in this manner.

DETERMINING BEST COMMUTATION UNDER BRUSHES

Having found the neutral position, the next step is to determine if the machine commutates with a minimum loss under the brush, this being the best commutation. The fact that a new machine operates without sparking at the brushes does not prove that the commutation is the best possible, for it is known that liberally proportioned machines can operate for several weeks without sparking or blackening at the commutator, when, gradually, sparking or blackening develops with the resultant rapid wear of brushes and commutator. The large speed variation between no load and full load and pumping action in motors may also be due to wrong proportions of the interpole winding, and it becomes necessary to check whether the interpole winding and interpole circuit are proportioned to give best operation. A short review of the commutation process will help one to understand better the method used in arriving at a just appreciation of the points that have been enumerated.

Referring to Figs. 8a and 8b, assume that the commutation of the current from the value $+J$ to $-J$ takes place in a resultant field of zero intensity, and that the resistance of the coil i' and the leads to the commutator is negligible compared with the contact resistance between the bars and the brush. The current $2J$ will distribute itself in inverse proportion to the resistances between the bars a and b and the brush,

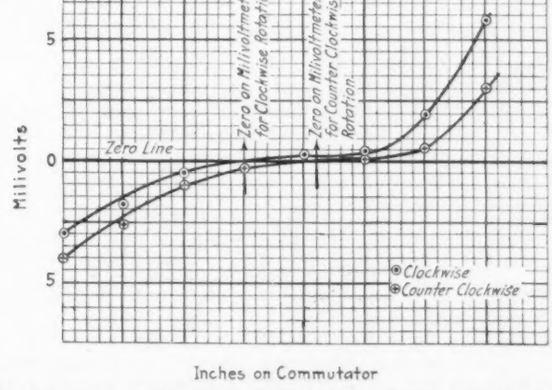


FIG. 7—FIELD CURVE FOR FOUR-POLE MACHINE HAVING EQUAL NUMBER OF MAIN POLES AND INTERPOLES

or in proportion to the areas of contact. The currents $i'a$ and $i'b$ in the leads to bars a and b being proportional to the surfaces of contact, it follows that the current density under any point of the brush will be the same. Assuming uniform contact resistance over the brush surface, the drop of potential, which is proportional for any point under the brush AB to current density times contact resistance per square unit, will be the same.

If a millivoltmeter is connected then to two contact wires M, N (see Fig. 9), and point M applied to the brush and point N successively to points 1 to 6 on the commutator, as shown in Fig. 9, the same difference of potential will be read. Plotting these readings in Fig. 10, we obtain for a negative brush the straight line xy. The drops in voltage are for a negative brush positive because the potential of the brush is higher than the potential of the commutator copper.

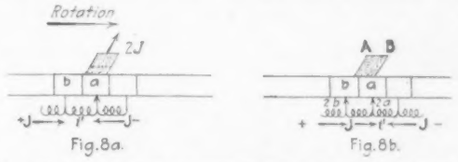


FIG. 8—DISTRIBUTION OF CURRENT IN COMMUTATOR BARS UNDER A BRUSH

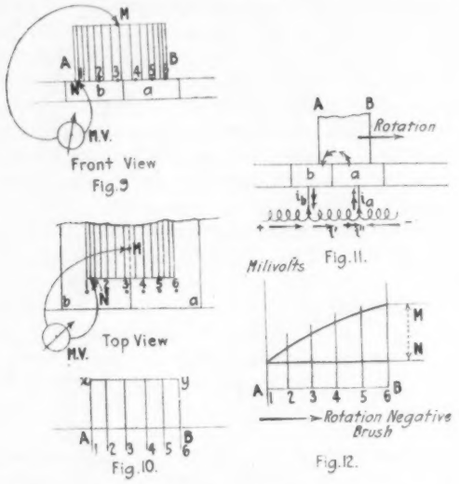
In the case considered the current in the middle coil Fig. 8 dies down at a uniform rate from the value $+J$ to zero value at a point corresponding to the middle of the brush, and rises then to the value $-J$ by the time the short-circuit is opened. This is the ideal or straight-line reversal. The experiment described can be performed with the simplest means and under the most adverse test conditions. Its findings give a very valuable indication showing the performance at the commutator.

The curve shown in Fig. 10 corresponds to ideal commutation and is only approximated in practice. Commutation in a uniform field, void of magnetic flux, is practically impossible. The armature winding tends to set up a magnetic field when carrying current and the short-circuited coil carries with it in space a magnetic field of varying magnitude during the process of commutation. It is the function of the interpole to cancel these fluxes and produce a commutating zone void of flux, as explained above.

If the corrective action of the interpole is insufficient, then the coil while under the brush tends to carry current in the same direction as before its terminals were short-circuited. The current i'' (double-arrowed current in Fig. 11) adds itself to current i' (single arrow in Fig. 11) and increases the current in the lead ia and the current density under the brush tip B. It decreases the current in the lead ib and the brush density at the brush tip A (see Fig. 11).

Still assuming uniform contact resistance, the voltage drop at the brush tip B will have increased, while at brush A it will have decreased. The drop in voltage along the face AB of the brush taken with a millivoltmeter, as described in Fig. 9, will be lower at A and higher at B, and will have along AB the shape shown in Fig. 12. The difference in voltage MN sends a circulating current through the brush which is limited

only by contact resistance between brush and commutator, the resistance of the leads *ia*, *ib* and the resistance of the coil. All these resistances being relatively low, a very heavy circulating current will be allowed to flow. At the instant the brush leaves the bar *a* this heavy current is suddenly interrupted. As long as the energy consumed in the opening spark stays below certain limits, depending upon the grade of the



FIGS. 9, 10, 11 AND 12—VOLTAGE DROP FOR NEGATIVE BRUSH DURING COMMUTATION WHEN INTERPOLE IS TOO WEAK

brush, and which, according to recent tests, seems to be about 5 watts per centimeter length of brush, the sparks are small, hardly perceptible and not very destructive. The commutation shown in Fig. 12 is the result of too weak an interpole, and it is said that the machine is under-compensated.

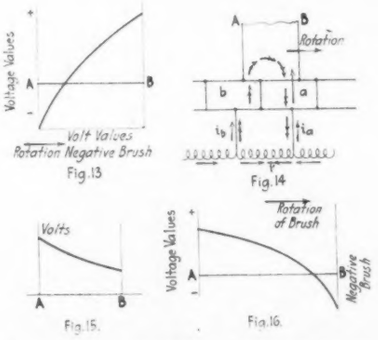
Provided the section of the interpole proper is ample and the magnetic circuit of the interpole is not saturated, a reduction in the air-gap under the interpole by addition of sheet-iron shims will materially help to improve commutation. The addition of more turns of the interpole would be the next step toward correcting the trouble. If the magnetic circuit is saturated, then a reduction in face area of the interpole, by cutting down the edges in a tangential direction, will bring relief through increasing the magnetic induction in the air-gap, while the total interpole flux continues to be constant.

STUDYING ACTION OF INTERPOLE BY BRUSH-POTENTIAL CURVES

The conditions just described are very much accentuated if the interpole is reversed, for then the interpole flux, instead of tending to produce a neutral zone, adds its flux to the armature reaction flux and the flux of the short-circuited coil. The brush-potential curve shown in Fig. 13 depicts the condition under the brush with a reversed interpole and is a very good indication of this trouble. In taking the curve the millivoltmeter reverses its reading while we move the contact point along the brush in the direction of rotation. If the interpole flux is too strong, then the coil while under the brush tends to carry current in the direction after the commutation has been completed. This action is shown from Fig. 14, where the current *i'* (double arrow) produced by the excess interpole flux is increasing the current density under the bar *b* or leading brush tip *A*, and decreasing the current density under bar *a* or trailing brush-tip *B*. For a negative brush the brush-potential curve, taken as explained by means of Fig. 9, will have the shape shown in Fig. 15. This action of the interpole is expressed by saying that the machine is over-compensated. If the machine is very much over-compensated, the brush-potential curve will take the form shown in Fig. 16. For a negative brush and taking the readings under the brush in the direction of rotation, the millivoltmeter readings may change from a positive value to a negative value.

It is a matter of experience that a slight over-compensation is helpful in obtaining sparkless commutation. It has also been observed that a machine can stand much more deviation from compensation for constant-current density under the brush when the machine is over-compensated than when the machine is under-compensated. This is explained by the fact that with under-compensation the current density is increased at the leading brush tip *B* (see Fig. 11) or at the tip which breaks the circuit of the short-circuited coil, while with over-compensation the current density is lowered at the leading brush tip *B* (see Fig. 14).

Over-compensation is most harmful in machines working with a weak main field, such as adjustable-speed shunt motors at the higher speeds. Referring to Fig. 17, which represents the case of motors running counter-clockwise, we find the direction of current generated by rotation under the interpoles in the short-circuited coil *SS* by means of the Fleming rule, for instance. Since we have assumed over-compensation, this will also be the direction of the resulting current in the short-circuited coil in *SS*. We notice that the coil *SS* tends to produce a flux opposing the flux of the main-pole field coil *FF*. In consequence we have, when the load is thrown on, the same action as in a differential compound motor. Fig. 18 shows the speed of the motor in function of time after the load is thrown on the motor, in case the conditions of the magnetic circuit, the electric circuit and the load are such as to damp out the first increase in speed due to the action of the short-circuited coil. If, on the other hand, conditions are unfavorable, the original impulse is strengthened and the speed-time curve takes the shape shown in Fig. 19, the motor operation becomes unstable, and the machine "pumps." The same phenomena repeat themselves which have been previously described in connection with a backward shift of the brushes from the true neutral position. The danger of unstable operation is increased the weaker the main field and the greater the inertia of the armature and load connected to same.



FIGS. 13, 14, 15 AND 16—BRUSH-POTENTIAL CURVES, SHOWING ACTION OF REVERSED INTERPOLE AND OVER-COMPENSATION

Further conditions affecting instability are:

1. Ratio of armature ampere turns to field ampere turns. Any increase in this ratio will increase the liability to pumping (or hunting, as it is sometimes called).

2. Saturation of main magnetic circuit. The lower on the saturation curve the motor works the greater the danger of instability.

3. The greater the ratio of self-induction to resistance (including rheostat resistance) in the shunt winding, the less danger of instability. Hence increasing the size of the shunt-field wire without changing the number of turns will reduce the tendency to hunting.

A few turns of compound winding will effectively oppose the tendency of the short-circuited coil to weaken the main pole. Many interpole motors now on the

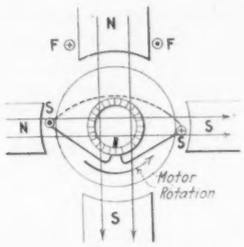


Fig. 17

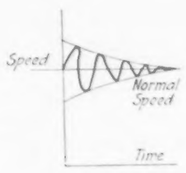


Fig. 18

FIGS. 17 AND 18—DIRECTION OF CURRENT IN SHORT-CIRCUITED COIL UNDER INTERPOLE, AND SPEED-TIME CURVE AFTER LOAD IS THROWN ON

market have such a winding on the main pole—this winding being called a stabilizing winding. Short-circuited sleeves around the interpole are of little value, in the writer's experience.

All motors showing a rising-speed characteristic from no load to full load at any speed will be in danger of being unstable in operation, and for this reason it should be required from any machine working with field weakening to show a dropping speed characteristic at the high speed between no load and about 50 per cent overload. The remedy, if we find the machine over-compensated, is obvious. Increase the interpole air-gap if possible. Take some of the turns off from the interpole if this can be easily accomplished. It is not recommended to shunt part of the interpole current through a resistance. A non-inductive resistance should never be used where the load is sudden and fluctuating, as in railway generators for instance.

It sometimes occurs that an interpole machine operates quite well at light loads but sparks badly at overloads. If the brush-potential curve obtained at light load has the shape of Fig. 15, indicating over-compensation, while the brush-potential curve obtained at overload has the shape of Fig. 12, indicating under-compensation, it is a sure sign that the interpole magnetic circuit is saturated and probably the section of the interpole too small. Cutting down the face of the interpole in a tangential direction will help. If the distance between main and interpole tip is small, this will at the same time reduce the interpole leakage and thus further improve commutation.

With wide brushes the brush-potential curve sometimes takes the shape shown in Fig. 20. If sparking occurs, it can be reduced by reducing the width of the brush from AB to $A'B'$, provided the current density under the brush is not unduly increased by doing that. The brush-potential curve is also valuable in cases where the unit is large, making it impracticable to test the machine under full-load conditions. All that is necessary is to take the brush-potential curve with the armature short-circuited, the fields being just enough excited to send full-load current through the armature and interpoles. The same applies to high-voltage machines where it would be dangerous for the operator to take brush-potential curves under full-voltage condition.

Owing to the different distribution of leakage flux under full-field condition, this is theoretically not quite correct, though it is quite close enough for practical work.

METHOD OF OBTAINING BRUSH-POTENTIAL CURVES

The following procedure has proved satisfactory in taking brush-potential curves: Since the shape of the curve is the point of interest, in order to facilitate comparisons it is advisable always to take the curve at the brush, the potential of which is higher than the potential of the commutator—the negative brush in a generator, for instance, and the same rotation (clockwise in the above curves). To take the curve two copper needles can be used, but two ordinary writing pencils well sharpened have proved very useful for the purpose.

A strip of cardboard paper, perforated with holes about 1/16 in. in diameter and spaced about ⅛ in. apart, will do good service in obtaining the points on the curve. The strip can be laid over the commutator surface and fastened to the two brush-holder studs adjacent to the brush under examination. A uniform pressure on the contacts is desirable for obtaining most consistent results. If the curve is taken as suggested at the negative brush, care must be exercised to apply the positive terminal of the millivoltmeter to the brush and the negative terminal to the commutator copper. A positive reading on the voltmeter will be plotted as a positive ordinate. If the voltmeter leads have to be reversed, the reading will be plotted as a negative ordinate.

In the deduction of the brush-potential curves it is assumed that drops in voltage between commutator and brush are proportional to the local current density. This is only true in the case of ideal commutation, for then the density is constant under the brush. As a matter of fact, the drop in voltage is not proportional to the current density; but if we should plot the drop in voltage against the current density we should obtain a curve approximating a hyperbola, the drop in voltage becoming constant when the current increases indefinitely.

Furthermore, we have to keep in mind that the current density varies along the brush not only in space but also in time. In consequence, we cannot attribute any quantitative significance to the brush-potenial curve and cannot from the brush-potential curve construct the curve of distribution of current density under the brush. The disparity between the actual distribution of current density and the distribution deducted from the brush-potential curve will be the greater the more the commutation departs from the ideal commutation with constant-current density over the entire surface of the brush. Still, as a qualitative judgment of commutation, the brush-potential curve is an invaluable asset of the operating engineer. Qualitatively, all the above deductions stay, in spite of the fact that the assumption of uniform contact resistance between commutator and brush is incorrect. But it should be kept in mind that the better the commutation the more nearly correct these curves are.

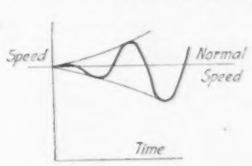


Fig. 19.

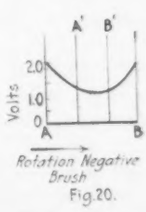


Fig. 20.

FIGS. 19 AND 20—SPEED-TIME CURVE UNDER UNFAVORABLE CONDITIONS, AND BRUSH-POTENTIAL CURVE FOR WIDE BRUSH

No attempt has been made in the above discussion to enter into the mathematical theory of commutation, for those interested in this matter will find articles on this subject in technical literature by eminent electrical engineers.

Opportunities for Young Electrical Engineers

II—In the Telephone Field

BY M. C. RORTY

Special Agent American Telephone & Telegraph Company

Mr. Rorty points out that while telephone engineering deals on the one hand with infinitesimal currents and delicate apparatus, it also concerns itself with plants of enormous value and with technical problems of wide range and great complexity. Administration of these properties is on a high and public-spirited plane, promotion proceeds with strict adherence to the merit system, employment is permanent, and the salary and pension scales are comprehensive and liberal. In the ELECTRICAL WORLD *of Feb.* 19 *the technical graduate's opportunities in the central-station field were discussed, and in issues to come the openings for the beginning engineer will be taken up from the standpoint of the manufacturing, electric-railway and allied industries.*

A ROUGH analysis of university registers and of the membership of the American Institute of Electrical Engineers indicates that this year's graduates in electrical engineering will distribute themselves between various lines of work about as follows:

	Per Cent
Telephone service and manufacturing	10
Other public utilities	25
Other manufacturing and selling	30
Federal, state and municipal service	5
Teaching	5
Consulting engineering and contracting	5
Miscellaneous	20

On the above basis, if the whole number of graduates in electrical engineering next June is 1600, as estimated in the introductory article of this series, the number taking up telephone work will be about 160, of which perhaps one-third will be employed in the manufacture and sale of apparatus and two-thirds with operating telephone companies. It may be estimated, further, that about 10 per cent of the 160 will establish themselves with the so-called "independent" telephone and manufacturing companies and about 90 per cent with the companies making up the Bell system.

Letting these figures stand as an indication of the extent of the demand for electrical-engineering graduates in telephone work, the nature of this demand and the special character of the opportunities offered may perhaps be comprehended more clearly by reviewing briefly the rapidly changing conditions under which the telephone business has been built up.

In 1897 the number of telephones in service in the United States was less than 500,000, and the period from 1876 to that date had been primarily one of technical development, during which there had been perfected, successively, hard-drawn copper wire, balanced metallic circuits, the solid-back transmitter, dry-core lead-covered paper cable, and the central-energy multiple switchboard.

From 1897 to 1908 there followed a period of very rapid expansion, with an accompanying increase of telephones in service from about 500,000 to over 5,000,000. During this second period there came, also, a wave of competitive development, some of which served a useful purpose by filling gaps in the service left vacant by the original telephone companies, but a considerable part of which was based primarily upon the hope of immediate profits for the promoters, without serious consideration as to the permanency and usefulness of the investments so made.

The panic of 1907-1908 marked a change from this period of forced expansion and excessive competition, and since 1908 there has been a more gradual growth, at an annual rate of increase of about 8 per cent, which has carried the total number of telephone stations from about 5,000,000 on Jan. 1, 1908, up to about 10,500,000 on Jan. 1, 1916. These stations, and the corresponding employees and investment, are distributed roughly as follows:

	Bell-Owned	Bell-Connecting	Independent	Total
Stations	6,156,000	2,995,000	1,350,000	10,501,000
Employees	156,000	70,000	34,000	260,000
Investment	$880,000,000	$180,000,000	$170,000,000	$1,230,000,000

In addition to the preceding, the Western Electric Company, which is the manufacturing branch of the Bell system, has an investment of about $50,000,000 and employs from 20,000 to 30,000 hands during normal times, while the several independent manufacturing companies have together an investment of, perhaps, $12,000,000 and employ about 6000 hands.

The more recent developments in telephony have been specially characterized by a growing desire on the part of the public and the public service commissions to avoid the wastes and duplications of competition, and by a growing willingness on the part of both Bell and independent telephone interests to work together toward the establishment of stable conditions in the business. During this latter period, also, there has been a very general regrouping of both Bell and independent companies into larger operating units, and a very general adoption by these larger units of the so-called "functional" type of organization, under which plant, traffic and commercial lines of work are specialized over considerable areas and no one man in the ordinary telephone exchange has actual administrative control over all functions.

Considering the preceding in the light of its bearing upon the opportunities for the electrical-engineering graduate, it is obvious, first of all, that conditions in the Bell organization must very largely determine conditions in the industry as a whole. It is obvious, also, that the business has already passed out of the pioneer stage into one where the emphasis must increasingly be upon thorough organization and reliability of operation, and where opportunities for the securing of individual control, even of small units, have become practically non-existent. The young electrical engineer who takes up telephone work must, therefore, be prepared to enter a highly specialized service in which individual initiative and special brilliancy of performance will secure their fullest rewards only when coupled with consistently sound work and good team play, and in which, in particular, the demand for men of the pure "promoter" type, if it exists at all, is extremely limited. With this single exception, however, the business calls for a wide range of capacity and special ability.

In the great federation of telephone companies that make up the Bell system, the central organization is

the American Telephone & Telegraph Company. This central organization maintains very extensive accounting, legal, commercial and engineering departments, which are in close and continuous advisory relation with the field companies and with the Western Electric Company, and also, through its long-distance-lines department, directly operates the longer telephone lines.

The field companies are divided into eight major groups, with headquarters at Boston, New York, Chicago, Atlanta, St. Louis, Omaha, Denver and San Francisco respectively. Each of these groups has its separate directorate or directorates, its full corps of corporation officials, its centralized engineering staff, and a very large measure of independence of action within the territory it serves. In the majority of the groups the area served is split up for operating purposes into two or more divisions, each covering one or more states and headed by a general manager, who has an engineer as staff assistant and a field organization that is specialized along plant, traffic and commercial lines. Under this arrangement plant maintenance and construction for an entire division are handled by a general superintendent of plant; telephone traffic is handled by a general superintendent of traffic, and public relations, collections and the securing of new business are handled by a general commercial superintendent. Each of these superintendents has a small staff organization and a line organization divided by districts and then by exchanges.

Considering now the opportunities that exist in each branch of work and the special qualifications that are required, the point should be made, first of all, that the electrical-engineering graduate has open to him not only those positions where special technical training is required but also those where the only requirement is natural capacity plus a general mental training. As an example of this latter class of opening, it may be noted that a number of college graduates have recently been employed in telephone accounting, and there is, of course, no reason why such work should not be successfully undertaken by a graduate in electrical engineering who has a taste for analysis and statistics. However, it may be assumed that electrical-engineering graduates, as a class, will be interested primarily in those lines of work where their special technical training will be of more or less direct value. Such openings exist principally in the plant and engineering departments, and to a lesser extent in the traffic and commercial departments.

In respect to these openings, it is, of course, unnecessary to say that the graduate of normal personality and of versatile and well-balanced intelligence may feel assured of a substantial success in any line. The real problem is to indicate the directions in which the most effective work may be done by those who are less versatile or who have pronounced special inclinations. Here, however, it is easy to err by being too specific. Nearly every position or line of work that can be named is apt to have its unsuspected ramifications. The difference between success and failure in what seems to be purely an administrative position may hinge on a difficult piece of analytical reasoning, while, in the reverse direction, the success or failure of a piece of pure research may depend on the ability of the man in charge to select and control the proper type of subordinate. Furthermore, even when the work can be exactly defined, it is not easy to say just what personal characteristics are required for its successful handling. The theoretical type of executive is alert, observant, judicial and decisive. Yet a study of any group of men who have been notably successful in administrative work may reveal nothing more in common than perseverance and a strong desire to see concrete results accomplished. And, finally, in young men mental development often proceeds by spurts, first in one direction and then in another, so that the student of twenty-one years may become the business man of thirty-five years, or vice versa.

Under these circumstances it is not surprising that the most skilled of executives in any line of business, even when working under the most favorable conditions, will not claim more than 75 per cent of successes in their choice of college graduates for business and technical positions. These difficulties in defining the exact requirements of positions, and in determining the appropriate human qualifications, are, however, only further reasons for doing all that it is practicable to do in the way of furnishing the prospective electrical-engineering graduate with information that may enable him to assist intelligently in the process of selection.

Considering the Bell system as a whole, it is probable that of the electrical engineering graduates employed this year about 15 per cent will locate with the general staff of the American Telephone & Telegraph Company, 35 per cent with the manufacturing organization, and 50 per cent in field work with the several operating groups and the long-distance-lines department.

With the general staff of the American Telephone & Telegraph Company the demand for recent graduates in electrical engineering is largely along the line of technical and semi-technical research work in the engineering department, although this department as a whole contains a large proportion of men with field experience who are engaged in studies of operating, plant-maintenance and construction methods, as well as in the preparation of development plans, the supervision of inventories and appraisals, and other of the broader economic phases of engineering work.

In the Western Electric Company the demand is for research workers, designers, manufacturing experts and factory executives, and for technically trained salesmen from whose ranks may be recruited the executives for the distributing end of the business. In this respect the requirements are much the same as in any electrical manufacturing and selling organization and cover the whole range from the pure student type to the pure business type.

With the various field companies, the central engineering organizations and the division engineers have need for a limited number of graduates of the student type and for a larger number of practical designers and constructors. The plant line organization has need, also, for graduates who combine administrative ability with technical knowledge. Transfers between the engineering forces and the plant line organization are, furthermore, frequent, and there is as a result a natural tendency for those with special technical qualifications to gravitate into the engineering forces, while those with special executive ability tend to locate in time with the line organization. On the whole, the advantage probably lies fairly even between those who enter the various engineering departments directly and those who begin as telephone installers, cable test men, inspectors, switchboard troublemen, etc., in the line organization.

In addition to the more obviously technical work along plant and plant-engineering lines, there is a broad field open, in the traffic and commercial departments of the field companies, for electrical-engineering graduates who have administrative ability. In the traffic organization this ability must be combined with tact in the handling of service relations with subscribers. In the commercial side of the work there is need, in addition, for the general qualifications that go to make up a good salesman. Both branches of the work have also their staff organizations in which there is a limited demand

for research work in the study of operating costs and methods, rate schedules, etc.

What has just been said in regard to conditions and opportunities in the Bell organization applies, also, in a general way, to the independent operating and manufacturing companies. The differences that exist are mainly due to operation in smaller units, with a correspondingly lessened degree of specialization, and to the tendency for the independent manufacturers to undertake for their customers a considerable proportion of the broader engineering work that in the Bell organization is handled by the general staff of the American Telephone & Telegraph Company.

No survey of opportunities in the telephone field is, however, complete that does not touch upon certain more or less intangible elements in telephone work.

Telephone engineering deals, on the one hand, with delicate apparatus and with infinitesimal currents, but, on the other hand, it concerns itself with plants of enormous value and with technical and scientific problems of wide range and the utmost complexity. The magnitude of the values involved is strikingly evidenced by the fact that the expenditures for telephone construction in the United States during the eight years when the Panama Canal was under construction were about double the expenditures on the canal itself. Telephone engineering is also specially notable for thoroughness of attention to detail, for breadth of view, and for the foresight that is displayed in planning for future growth and contingencies.

Administrative work in the telephone field is on an equally high plane and is characterized particularly by the skill with which the advantages of local responsibility and of centralized supervision have been combined in the larger operating units. The natural interest that the business inspires is, furthermore, great. Managements, on the whole, are conspicuously public-spirited. And permanency of employment, a generally rigid adherence to the merit system, and liberal salary and wage scales, together with comprehensive pension and sick-benefit plans, have combined to build up in the telephone organizations as a whole an enthusiasm and *esprit de corps* that is not the least of the attractions that the business holds forth to the young electrical engineer.

Discussion by Readers

Herewith are two of the letters received commenting on the preceding articles of this series, printed Jan. 15 and Feb. 19. The editors will gladly publish communications which will help the young electrical engineer get his sense of direction in a great industry.

To the Editor of the ELECTRICAL WORLD:

SIR: In considering the broad field of opportunities for all young engineers it seems apparent that each phase of engineering has characteristics similar to all the others, and the discussions which have appeared so far might easily have been made even broader in their application.

The co-operative principle, as applied at the University of Cincinnati, seems to meet quite satisfactorily the situation which confronts the young engineer. These engineering courses extend over a period of five years and include summer terms in addition to the usual college year periods. The students spend half their time in the various industrial and commercial activities of the community and half their time in the college of engineering.

By the time they come to graduate the students have had an actual contact with practical affairs which seems to make them of real practical value as engineers, judging by the results obtained so far.

The co-operative courses have been in operation now for more than ten years, so that the data obtained may be considered as having real value. The subject under discussion refers particularly to the conditions confronting young engineers upon graduation; but it is difficult to consider this matter without reference to what these young engineers have been doing previous to graduation. It is important to know to what extent they have already been brought into direct personal contact with the problem of finding a place in the engineering world.

The "vocational-guidance" epidemic seems to have passed through its most virulent period and to have reached a point where it is harmless. Its effects have probably been beneficial, all things considered. The natural lag of conservatism in our institutions of higher learning probably prevented this epidemic from taking an acute form in connection with young engineering graduates. The classification of virtues and qualities necessary for success, and the candid study of a young college graduate by himself and others with a view to determining in advance his value or caliber as a producer and his proper field of activity, are certainly very interesting and harmless developments of the vocational-guidance idea.

About three years ago the College of Engineering of the University of Cincinnati attempted an unbiased test of the various psychological methods of determining what a man should do. We were in an excellent position to make this test. We had a considerable number of students engaged in actual engineering work of various kinds and knew very accurately what degree of success they were meeting. Knowing this, the purpose of the tests was to determine whether the standard, approved psychological methods could be used with any degree of accuracy. Neither the department of psychology nor other psychologists could tell from the results of the tests what any individual's characteristics were or in what field of activity success might lie.

Mr. Gilchrist's proposition to make a systematic effort to locate a number of college students during vacation periods is worthy of more than passing mention. In the ordinary four-year college course the value of the summer vacation as an opportunity for getting into personal contact with practical affairs cannot be overestimated. The remuneration is certainly a matter of secondary importance. This summer experience would give even those students who take the vocational-guidance idea too seriously three distinct opportunities for contact with practical affairs, with long periods for reflection and discussion intervening.

Unfortunately, the amount of data so far available in connection with our co-operative course in electrical engineering is relatively small, and the time covered by these data is relatively short. Besides, the scope of this brief missive will hardly permit a discussion of them; but there seems to be no avoiding the conclusion that the idea that service must be rendered by the young engineer before he or anyone else can have an intelligent measure of his capacity for service must be hammered into him in some effective manner. After all, the gage or caliber of a man is determined in service. No one can tell from the manner in which prospective engineers approach and masticate the mental pabulum offered at our institutions of higher learning, so-called, the kind and amount of ability, and the endurance, which will result from the process of digestion. The most difficult thing in engineering education as conducted in most technical schools is to introduce practical, effective contact with engineering.

A. M. WILSON,
Professor of Electrical Engineering, University of Cincinnati.

To the Editor of the ELECTRICAL WORLD:

SIR: I have read your article in the ELECTRICAL WORLD of Jan. 15 with much interest and think your analysis there is very valuable for college professors who are trying to guide their students vocationally. It reminds me somewhat of a similar analysis made by Dean Schneider of Cincinnati several years ago which he uses for this purpose. Of course, the definition we are seeking is for a different purpose, and therefore is to be cast in different terms.

C. R. MANN,
The Carnegie Foundation for the Advancement of Teaching, New York.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Securing Meter Test Current from Portable Batteries

How the Potomac Electric Power Company Uses Nickel-Iron-Alkaline Storage-Battery Cells for Testing Customers' Meters and Large Watthour Meters

BY R. S. WHITE

A method by which test current is secured from portable storage batteries when testing direct-current watthour meters similar to that described in the Feb. 12 issue of the ELECTRICAL WORLD, page 373, has been used in the meter department of the Potomac Electric Power Company of Washington, D. C., for a number of years. The old lamp-bank method formerly used proved unsatisfactory, and at first a lead storage-battery cell with an adjustable wire resistance was employed. The results secured with this apparatus were good, and the method was adopted for general use, the nickel-iron-alkaline cell being employed upon its appearance in order to secure a convenient and easily portable outfit.

DATA ON OUTFIT FOR TESTING DIFFERENT SIZES OF METERS

Meter Ratings, Amp.	Test Outfit Employed	Weight Complete, Lb.
5 to 25 (inclusive)	Resistance load box	7.75
Up to 150 (inclusive)	One type A4 cell	15
Up to 300 (inclusive)	Two type A6 cells	42

For shop testing and laboratory use a carbon rheostat is used, but for ordinary testing of customers' meters a small detachable resistance board connected to the battery, as shown in Fig. 2, is used. This board has a suitable number of binding posts with resistance wires arranged as indicated in the illustration. When connections between the rotating standard and resistance-board binding posts are properly made, with all joints and contacts good, a current of 120 amp. may be obtained and used through a three-wire meter-test circuit with one nickel-iron-alkaline type A4 cell.

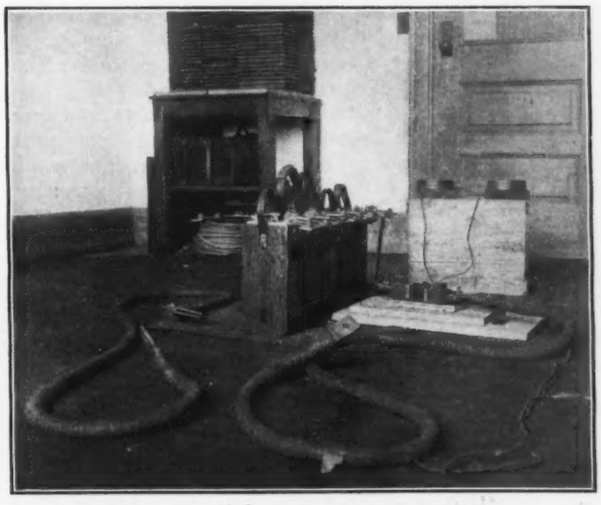


FIG. 1—OUTFIT FOR TESTING 1200-AMP. WATT-HOUR METERS

In Fig. 1 an output is shown for testing 1200-amp. watt-hour meters, using a 1000-amp. shunt and millivoltmeter for current measurement. Five cells of type A6 (insulated from the floor) are connected in parallel, and 450,000-circ. mil flexible cable leads, each about 10 ft. in length, are suitable for approximately full-load current for the test. Half load may be obtained by disconnecting the clip end of the cable from the battery "bus" and inserting a smaller sized cable lead in addition. Light-load test requires a smaller shunt for the current reading, which is added to the test circuit, together with sufficient extra resistance to bring the current down to the desired amount. A small, portable wire resistance board similar to that shown in Fig. 2 will be found useful for this purpose. In testing 600-amp. meters only three cells are needed, and the same cable leads are used.

FIG. 2—NICKEL-IRON-ALKALINE STORAGE BATTERY AND RESISTANCE BOARD FOR TESTING CUSTOMERS' METERS

The clip attachment to the battery "bus" should be firm enough to insure against any accidental disconnection and will be found to be a most convenient way of opening the test circuit for an adjustment.

Welding Lap Flanges of Steam Pipes to Avoid Gaskets and Steam Leakage

At the recent annual meeting of the American Society of Mechanical Engineers in New York considerable interest centered round the methods of installing high-pressure steam-piping systems of large central stations. The piping system must be capable of handling large quantities of steam at high pressure and high degree of superheat efficiently, safely and reliably and must be capable of remaining in service for long periods without attention or inspection.

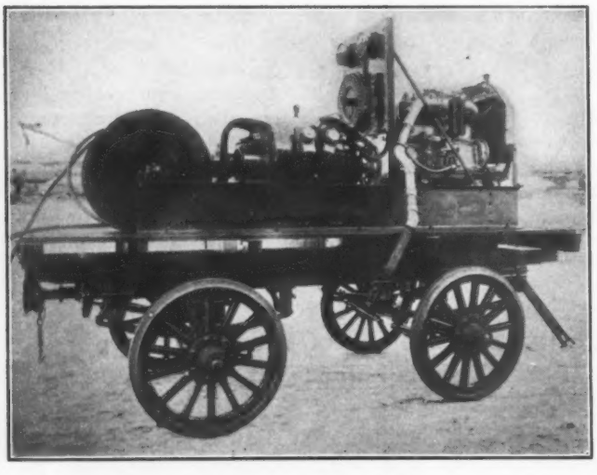
During the discussion reference was made to the practice of fusing together the lap flanges of pipes to avoid the blowing out of gaskets and steam leakage. It was pointed out that one large company, the Com-

monwealth Edison Company of Chicago, is now doing this at its Fisk Street station. This station contains ten 10,000-kw. vertical type, one 25,000-kw. and one 20,000-kw. horizontal type turbo-generator. It is on this latter installation that fused flanges are now being used between the steam header and the turbine. Instead of using the customary copper-asbestos gaskets inserted between the flanges, the flanges are drawn up face to face and bolted rigidly together. The edges are then welded together. The thickness of this weld is quite small since the intention is not to increase the mechanical strength of the joint, but to enable the elimination of gaskets and in this way prevent the leakage of steam.

The welding of flanges in this manner has proved satisfactory, since there are no gaskets and there is entire absence of leakage. Their use, therefore, not only increases safety somewhat, but reduces a possible station-operating trouble. In large stations electric or oxy-acetylene outfits for welding and cutting are usually available, hence there is little difficulty in making and unmaking the joints quickly when occasion arises.

Portable Equipment Used by City of St. Paul for Thawing Frozen Pipes

A gasoline engine directly connected to a low-voltage direct-current generator, a switchboard and a reel of cable assembled on a small truck, as shown in the accompanying illustration, make up an outfit that is being effectively used by the water-works department of the city of St. Paul, Minn., to thaw out frozen water pipes. The generator, built by Roth Brothers & Company, Chicago, Ill., is rated at 20 kw. at 40 volts and driven by a four-cylinder, four-stroke-cycle gasoline engine made by the Capital Engine Works of St. Paul. The mechanical connection is through a leather-link flexible coupling. A voltmeter, an ammeter, a rheostat and a single-pole knife switch of 500-amp. rating are mounted on the switchboard. The reel holds 500 ft. of flexible copper cable of 300,000-circ. mil cross-section in 100-ft. lengths. Each length is fitted with terminal lugs. The



A 20-KW., 40-VOLT ENGINE-DRIVEN GENERATOR MOUNTED FOR THAWING FROZEN PIPES

various parts of the equipment are securely attached to a steel frame mounted on a Troy trailer of 1.5-ton rating, which is hauled about by a motor truck. The mounting is temporary, so that after the winter season the thawing unit may be removed and the trailer used for other purposes.

When the outfit is placed in service for thawing pipes serving a building, the positive terminal of the generator is connected through a section of the 300,000-circ. mil cable to the frozen pipe in the building between the meter and the street main and the negative terminal to the nearest outside fire hydrant, so that the circuit is through the lead or iron service pipe and the main to the hydrant. The connections at the hydrant and the pipe are made by the use of clamps which permit a surface contact sufficient to carry 500 amp. After the cables are connected, the engine is started and the voltage built up to between 30 volts and 40 volts, when the main switch is closed. A current flow of about 250 amp. is maintained for two or three minutes and then increased to from 350 amp. to 500 amp., depending upon how badly the pipe is frozen. Under these conditions G. O. House, superintendent of the water-works department, reports that the service line has been cleared in all cases within ten minutes. The outfit was developed by Mr. House and assembled by E. L. Sudheimer of St. Paul.

Trouble with Directly Connected Exciters Due to Polarity Reversal

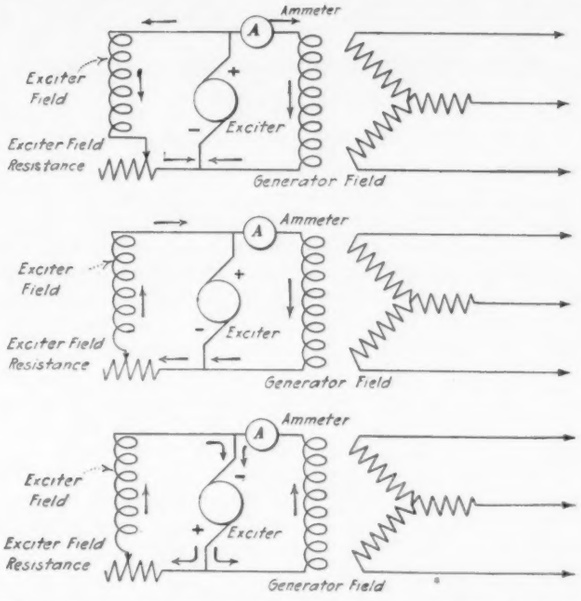
By Gilbert Rutherford

The use of directly connected exciters is coming more and more into favor, which is a rather interesting tendency in view of the strong sentiment against such a practice only a few years ago. With the increasing capacity of generators, whether steam-driven or water-driven, an exciter connected directly to the shaft of a generator is in many ways most advantageous, especially in large stations. The directly connected unit enables the generator and exciter to be treated as a separate and complete unit, resulting in greater flexibility and economy due to the higher load-factors and efficiency obtainable. The station wiring and heavy copper work are simplified and much less extensive, and the cost of the generator-field rheostat and the space it takes are obviated, as well as the joulean losses and means of disposing of them when the generator carries a load. There are, of course, instances where directly connected exciters may jeopardize reliability, but this is the case in a station of rather limited capacity rather than in a high-powered station.

In the operation of directly connected exciters trouble has been experienced in a number of cases on account of the exciter reversing its polarity. In the cases where trouble was reported the exciters were shunt-wound machines; in fact, this type is used to a very large extent for direct drive and where a Tirrill regulator is not employed. The absence of the series-field winding, which is not needed where parallel operation is not normally used, gives a more steady voltage under the conditions existing. The conditions immediately previous to the exciter-reversing polarity were something like this: The generator was carrying a very light load and this load was being decreased by reducing the input to the prime mover, at the same time lowering the generator voltage preparatory to taking the machine off the system. When the load had dropped to almost nothing the bus pressure suddenly went down. The meters showed that the current in the machine to be taken off the system had increased, with the power-factor meter still swinging somewhat. The operator at once imagined, and naturally, that too much resistance had been cut into the field rheostat, so that the generator terminal voltage had dropped very low, and he remedied this by bringing up the generator pressure again, probably to normal. The exciter now operated with polarity reversed.

These conditions have happened in a number of in-

stances known to the writer, and others have been reported by letter on good authority. The reason for the reversal of polarity of the exciter is easily explained, and will be better understood by referring to the electrical connections between generator and exciter in Figs. 1, 2 and 3. Fig. 1 shows the direction of the current flowing under normal operating conditions, Fig. 2



FIGS. 1, 2 AND 3—DIRECTIONS OF CURRENT THROUGH EXCITER CIRCUIT WHEN CONDITIONS ARE NORMAL, WHEN POLARITY IS REVERSING, AND AFTER POLARITY HAS REVERSED

at the time when the reversal is occurring, and Fig. 3 when the reversal has taken place and the normal conditions are apparently restored.

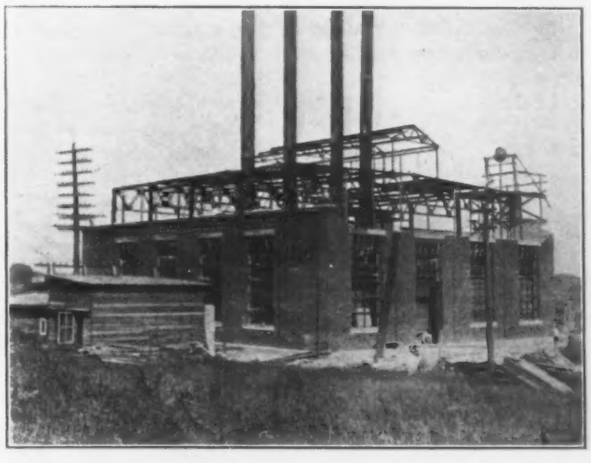
The phenomenon may be explained as follows: When the generator carries only a light load a comparatively small current is required in the generator field to give the proper terminal pressure and to counterbalance the ampere-turns of the armature. The exciter operates on the steep part of the saturation curve, where a small current increase gives a comparatively large increase in generator terminal pressure, and inversely. An alternator field is a highly inductive circuit, so that when the current flowing through it is changed the inductance tends to maintain the current in the same direction, irrespective of the change, for a definite length of time, according to the time constant of the circuit. Now suppose, further, that the steps of the rheostat are so large that the increments of change in voltage are extreme and the decrease in voltage sudden, which is exactly the condition existing in the cases under discussion. The sudden drop in voltage across the exciter permits the current in the generator field to discharge back through the exciter. This discharge current flows from the generator field through the exciter armature in the normal direction, but flows through the exciter field winding in the opposite direction to normal. This condition is shown in Fig. 2. The voltage drop across the exciter armature due to the discharge current is such that the current passing through the field reaches a value sufficiently high not only to demagnetize but to reverse the residual magnetism of the exciter. About this time the operator cuts out resistance in the exciter field rheostat with the intention of increasing the generator pressure. This it does, and the exciter builds up with polarity reversed. Everything now appears normal except that the ammeter and voltmeter in the generator-field circuit or exciter circuit read backward. The conditions in Fig. 3 prevail.

Whether the possibility of polarity reversal should be permitted to continue depends, of course, upon circumstances, and each system must be considered according to its own characteristics. It may be said that the larger the station the less harmful is such an occurrence likely to be, because the large station has probably all modern generators with comparatively high reactance internally and externally, so that the current flowing when the generator has practically no excitation will be kept within safe limits. At the time during which reversal of polarity occurs the unit is subject to quite severe strains on account of the comparatively high current, and these may be very severe with machines having low reactance. There will in any case be a fluctuation in the system pressure which, apart from being noticeable, may cause synchronous apparatus operating at the time to be thrown out of synchronism. Some companies maintain an emergency exciter bus so that any generator may obtain excitation irrespective of its own exciter, and here operating an exciter with reversed polarity would interfere with paralleling.

The remedy for preventing this trouble is to change the rheostat so that the increments of voltage variation, on the higher portions at least, have finer gradations. Before discarding the rheostat the variation should be carefully checked up step by step, at the same time trying the effect of changing the speed of travel of the motor driving the rheostat, because it may be found possible to prevent the generator field from discharging through the exciter field in this manner, provided that the rheostat steps are not too great.

How Electrical Troubles Were Eliminated During Reconstruction of Michigan Station

The first step in the rehabilitation of the power plant at Holland, Mich., was to build a temporary frame switch house outside the plant. To this small building all of the switchboard panels except the generator panels were moved. The generator panels were moved to the immediate vicinity of the machines whose outputs they controlled. When the work of placing the temporary



NEW STATION BEING CONSTRUCTED OVER OLD ONE AT HOLLAND, MICH, SHOWING TEMPORARY SWITCH HOUSE AT THE LEFT

switchboard was finished only four live wires, the bus wires of the two-phase, four-wire system, connected the generating machinery with the switching equipment in the temporary structure. No interruption in service occurred, despite the fact that practically a new plant was installed on the old site. James N. Hatch, consulting engineer, Chicago, planned the reconstruction.

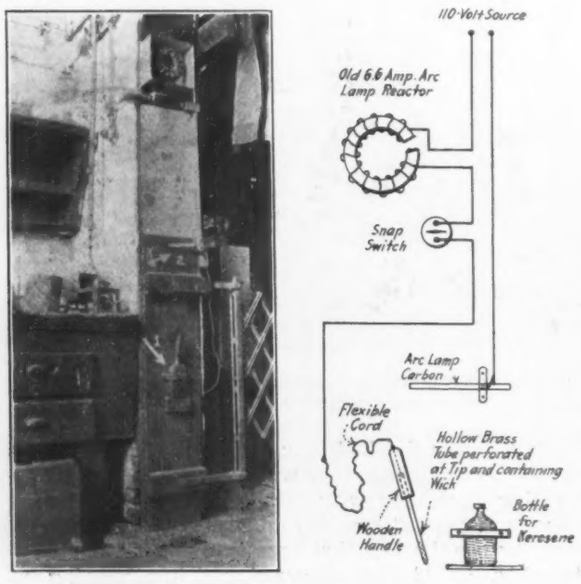
Method of Filing Continuous-Curve Station Records

BY A. R. HAYNES

In connection with the filing of recording-instrument continuous-curve sheets as given in the ELECTRICAL WORLD for Feb. 5, 1916, page 323, the following scheme used by the writer may be of interest. The method consists of cutting the sheets into twenty-four-hour sections and folding each sheet twice lengthwise. In the case of a chart with a feed of 3 in. per hour this results in a folded chart 9 in. long. The name of the station, the name or number of feeder from which the chart was taken and the date are then stamped on the outside. The folded charts for the day are filed by stacking in separate monthly compartments. It then becomes a simple matter to refer to any chart of a given date. This method appears to be preferable to that of hanging twenty-four-hour sections on wall pegs, as charts taken from nearly consumed rolls of instrument paper have an exasperating way of kinking and curling when being handled.

A Simple Method for Electrically Lighting Gasoline Blow-Torch

An electric blow-torch lighter has been installed beside a workbench in the power house of the Urbana & Champaign (Ill.) Railway, Gas & Electric Company. It is a home-made affair, put together at small cost, but it saves considerable time that is generally lost in hunting for matches, and incidentally it saves the matches themselves. Taps from a 110-volt house-service circuit, a reactor coil taken from an old 6.6-amp. arc lamp, an arc-lamp carbon held by two porcelain cleats, a hollow brass tube containing a wick and fitted with a wooden handle, and a small bottle of kerosene form the principal parts of the device. As may be seen from the accompanying photograph, the reactor is mounted in a galvanized-iron box on a column well up out of the way of the workmen. At a lower level the arc lamp carbon (2) may be seen. It is held in place by two cleats and is backed by a panel of slate so that the danger of grounding is eliminated. The kerosene bottle (1), containing the other terminal of the circuit, is placed at a still lower point within easy reach of a workman at the bench. To operate the lighter the workman merely strikes the tubular wick-container against the carbon, completing the electrical circuit and causing an arc, which ignites the kerosene. The flow of current in the circuit is limited to 6.6 amp. by the old arc-lamp reactor. This device has been successfully used in the power house for some time.

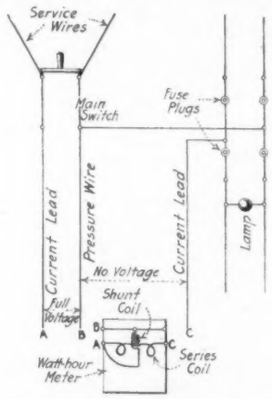


ELECTRIC LIGHTER FOR BLOW-TORCH USED AT WORKBENCH

Determining Proper Connections for Meter Loops

BY HENRY MULFORD

When a single-phase or two-wire direct-current watt-hour meter must be connected with a main-entrance switch and branch-circuit cut-outs at some distance from it, the following methods may be used to identify the current and pressure wires: If service wires have been installed so that energy is available at the main switch, then back the fuse plugs out of all the branch circuits except one. In this circuit connect a lamp, and



CIRCUITS AND METER TERMINALS TO INDICATE PROPER CONNECTIONS

then by means of a test lamp ascertain between which meter wires full voltage exists. Between one of these wires and the third wire no voltage will be found to exist by means of a test lamp. This wire is the pressure wire and may be connected with the corresponding terminal of the meter. If the meter connections are as shown in the accompanying drawing, the right-hand series terminal may be connected with the third wire mentioned previously and the left-hand terminal with the remaining wire.

If the service wires are not connected so that the main switch can be energized from the supply system, a magneto, preferably the series type, may be employed to identify the meter wires. For this purpose all of the branch-circuit fuse plugs should be backed out of their receptacles and a piece of bare wire connected across the lower terminals of the main switch. Then by testing with the magneto two of the three meter wires will be found which form a closed circuit. After these have been selected, connect the remaining wire with the right-hand series terminal of the meter, remove the bridging wire on the main switch, screw the fuse plugs into one branch circuit, and connect a lamp in that circuit. Then the magneto should be connected with the left-hand series terminal of the meter and each of the two remaining wires in turn to find which completes the circuit. This one is the pressure wire and should be connected with the corresponding meter terminal. The remaining wire should be connected with the left-hand series terminal of the meter. The proper connections are shown by the letters *a*, *b*, *c* on the service leads and at the meter.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Demonstrating by Neighborhoods

The Story of the Traveling Exhibit Tent Used by Indianapolis Central Station During Its Fall House-Wiring and Appliance Campaign

An interesting innovation in the demonstration of electric appliances has been devised and successfully used by the Merchants' Heat & Light Company of Indianapolis. It is a traveling tent equipment that has proved a practical means of carrying the advertising and demonstration of household apparatus directly to any district selected for development work. This is set up in a vacant lot in the center of the district and becomes at once conveniently accessible to all the women of the neighborhood.

A special tent has been prepared to provide an inclosed ground space 9 ft. by 12 ft. It is equipped with a front flap which may be used in a horizontal position to give shade in the daytime and in a vertical position as a "movie" screen at night. The entire outfit is arranged so that it may be set up in an hour, or may be pulled down and packed ready for hauling to some other vacant lot in about thirty minutes. In the tent a full line of electrical appliances are displayed and energy is available for operating them. This tent was routed through the city during the summer and early fall, making ten one-week stands in as many different localities. The crew attached to the tent consisted of seven men, most of them college undergraduates, who worked for $5 a week and a commission on all sales, an experienced salesman being in charge.

In general, it was the plan to keep two men at the tent continually while the remaining five solicitors called on all of the company's customers in the neighborhood to tell them about the tent and invite the ladies to visit it and see the daily demonstrations. The efforts of the solicitors to secure attendance at the portable store were augmented by letters sent from the sales manager to the company's customers living near the tent. One man slept in the tent at night to prevent theft. The total expense of operating this portable appliance store was approximately $160 a month, and the first cost of the tent, minus its electrical stock, was less than $100. From the standpoint of outright sales alone the portable exhibit proved to be a success, for the average weekly appliance sales amounted to $200, aside from the house-wiring contracts closed by the crew.

Enlisting the Friendly Drug Store—A Hint for "Wire-Your-Home" Month

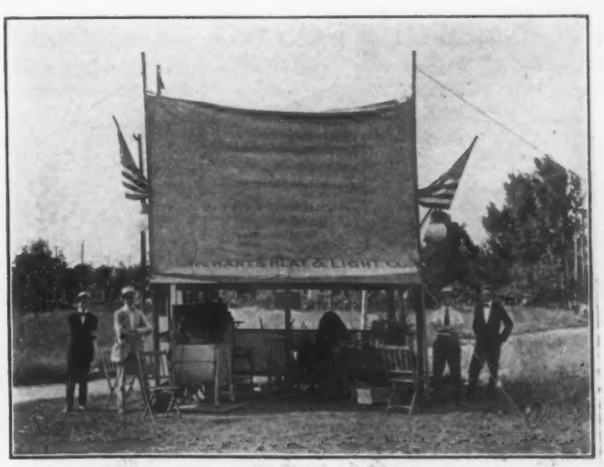
Central stations and contractors can find many valuable suggestions for their campaigns during "Wire-Your-Home Month" in the experience of other companies and dealers last December during Electrical Prosperity Week, when wiring campaigns played a prominent part in many cities, just as in "Wire-Your-Home Month" the sale of appliances will feature prominently. Plans for the sale of household-service devices are therefore pertinent and the value of the drug-store window should not be overlooked.

In Nashville, Tenn., during the week mentioned electrical appliances were consigned to seven contractors and dealers and to twenty-four drug stores, and twenty-eight special window displays were arranged. Mr. James E. Carnes, contract agent for the Nashville Railway & Light Company, says:

"We experienced no difficulty in securing the free use of these windows, and it was particularly gratifying to find all dealers and druggists in the most friendly attitude. We feel that the advertising value of having electrical appliances on display in twenty-four of the best drug stores in the city during the week amply repaid us for the trouble and expense of arranging displays, and very materially increased our holiday sales."

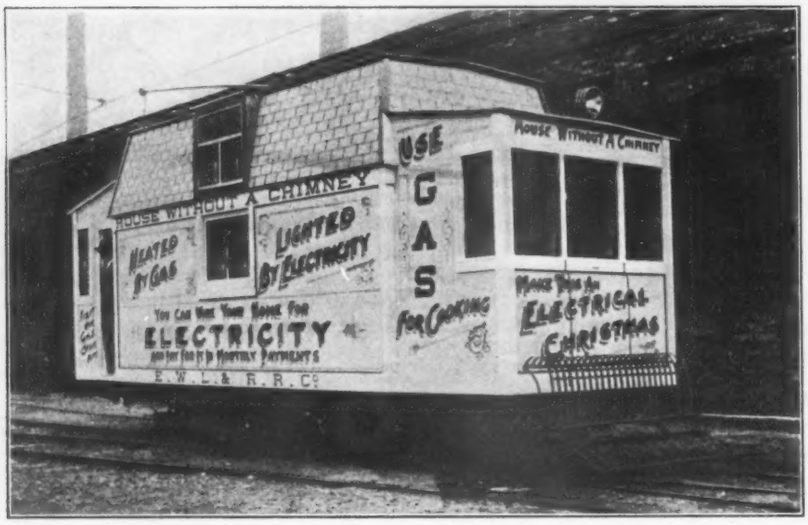
The coming activity in house-wiring naturally will stimulate a great deal of popular interest in the entire broad subject of electric service, and ample provision should be made to take advantage of it. The Nashville experience suggests one way.

"READY FOR BUSINESS" WITH THE DEMONSTRATION TENT ON A LOT WHICH ONE HOUR BEFORE HAD BEEN VACANT



WHEN DUSK CAME THE CANVAS SUNSHADE WAS HOISTED TO A VERTICAL POSITION AND BECAME A "MOVIE" SCREEN

"Wire-Your-Home" Advertising at Elmira, N. Y., with a Disguised Sand Car



The traveling "House Without a Chimney," which has been used with excellent publicity results in recent house-wiring campaigns by the Elmira (N. Y.) Water, Light & Railroad Company is a disguised sand car which is in regular service over the tracks of the local railway system. The sand car was covered with a light framework on which canvas was stretched, and the roof was made up of felt and shingles. Sand is taken into the car through the side windows of the "house." The cost of converting the sand-car exterior totaled about $40, according to F. H. Hill, general manager of the company. When the car is out on regular sanding duty no charge is made to the electric lighting department, but when the display is operated at other times purely for publicity purposes the expense of energy and crew is charged to the departments represented in the advertising. Although the car was arranged for the Elmira company's own use, it will be rented to merchants upon request.

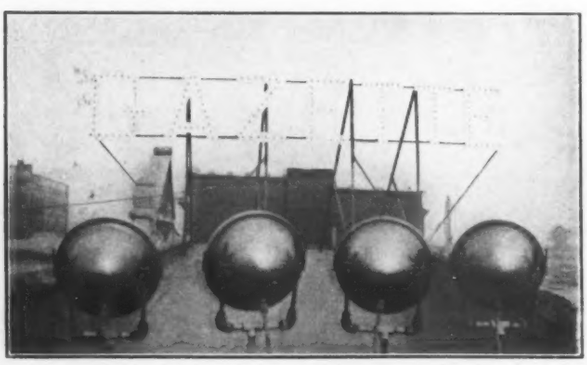
Bonus to Contractor for Each House Wired

To electrical contractors maintaining retail and display stores in Hartford, Conn., and employing solicitors who spend at least two-thirds of their time soliciting wiring in already-built houses, the Hartford Electric Light Company offers a bonus of $2 for each residence customer secured by the contractor for the company. It is stipulated that the "customer" shall have an installation of at least eight sockets, not including public hall lamps. This payment for sales work by the contractor applies to residential customers only. The bonus is awarded on the completion of the wiring, whether the apartment be occupied or not.

Moreover, to encourage further activity among the Hartford contractors, the electric-light company offers to furnish the contractor an order for advertising on any Hartford daily newspaper for 2 in. of advertising space for each customer secured, this space to be used to advertise the wiring of existing buildings. Upon request, in cases where the house owner's credit is satisfactory to the electric company, the latter will finance, as regards deferred payment, wiring contracts in individual cases.

How to Relight an Old Sign at Low Cost

For a long time the electric sign of the Champaign (Ill.) *Gazette* was "dead." It had been allowed to go without painting, most of its lamps had failed, and it was in bad repair generally. From time to time the local central-station salesmen and some of the electrical contractors offered proposals to the newspaper for putting the sign in good order and relighting it. The cost of carrying out these suggestions was, however, considered exorbitant until one contractor submitted a proposal to repaint the sign and flood-light it with four projectors. From the standpoint of both first cost and operating cost this offer was attractive. The contractor received the job, took the old lamps out of the sign and repainted it. Then he built an inexpensive iron-pipe framework to support four automobile lamps. From the old sign transformer on the roof he ran a line of conduit to his four improvised projectors and thus connected his lamps to the old service lines.



AN OLD ELECTRIC SIGN THAT WAS RELIGHTED WITH PROJECTORS BY AN INGENIOUS CONTRACTOR

A Rock-Bottom Price for Wiring—47 Cents per House

Through the columns of the Lancaster (Ohio) *Daily Gazette* the Ohio Light & Power Company recently offered to have house wiring done for prospective customers at the very low price of 47 cents per house. The offer as it read in several places of each issue of the paper is shown herewith. The company was able to make this offer because it was willing practically to give away an electric iron to secure a new customer, and because it had made a desirable co-operative arrangement with the local electrical contractors. According to Fred C. Morrison, new-business manager of the central-station company, the offer proved attractive and secured an entrance for electric service into many hitherto unwired homes.

47c. wires your kitchen and gives you a 60-cp. Mazda Lamp, if you buy a General Electric Iron at the regular retail price of $3.50. The total cost is $3.97, payable $1.37 down, $1.30 in one month, and $1.30 in two months. Do it now. 'Phone the Ohio Light & Power Company.

AN ATTRACTIVE HOUSE-WIRING OFFER ADVERTISED WITH SUCCESS AT LANCASTER, OHIO

Centralized Electricity Supply and the Jobber

What Some Wholesalers of Electrical Supplies and Equipment Think of the Movement Toward the Consolidation of Central-Station Properties

When asked the hackneyed question, "How's business out your way?" one day last week, a Western electrical jobber replied: "Business is pretty good, and it would be a great deal better were it not for the activities of several central-station syndicates operating in our territory. These companies have been and are continuing to buy small central-station properties in several States, and of course when the properties change hands their buying plans and methods are all rearranged. Then the jobber, if he would hold the business of his former central-station customers, must start afresh. He or his men must cultivate new acquaintances. Perhaps he must sell goods through a central purchasing agency for many of his customers who were formerly widely scattered. He must readjust his business to meet the change.

"All of this readjustment takes time, and while it is going on other things may happen. For instance, one Middle West jobber remarked a few years ago that his company had lost in a single year hundreds of thousands of dollars' worth of central-station business. Practically the entire loss in sales to central-station companies was attributable to the activities of holding companies which were uniting the central stations in that territory under a few heads and centralizing the purchasing power."

"But did you get this central-station business back when your concern had readjusted itself to the change?" the Illinois man was asked.

"Not all of it," he replied. "We never can hope to get all of it back, because the central-station holding companies have in several instances themselves become jobbers. They, of course, handle their own business. Now our salvation lies in taking up other lines—finding other business to replace the lost central-station sales."

"Perhaps your company will, in the future, tend to sell more and more electrical automobile accessories to replace this business," it was suggested.

"Possibly," he replied, "but before we enter that field to any marked extent I should like to know that a higher class of retailers is in prospect, because, as the automobile supply field is now, the chance of accumulating bad debts in that field is one I should hesitate to assume."

A jobber from the South had a story to tell about the same situation. He said: "I can get the syndicate business and can hold it, but it is undesirable. Syndicates are poor pay. For example, they will give the jobber a six-month note in payment for goods, and are very apt to ask its renewal at its expiration date." The Western jobber complained of having the same trouble, and declared that even when he asked 8 per cent on notes the central-station holding companies paid the interest rather than the bill.

Another jobber from the Southwest stated that he had his "syndicate" troubles, too, and said that during the recent period of dull business the small municipal-plant business had been his "bread and butter." He likened the conditions in the jobbing business to-day to those that existed several years ago when the Bell Telephone Company succeeded in buying a great many of the independent plants. Following that movement the electrical jobbers were forced to pay more attention to the central-station business. Now that business is waning, and the question confronting the jobbing industry is, as pointed out by the speaker, "What will be a salable substitute line of goods?" The answer has not yet been found, but the jobber believes he will find it, continued the spokesman, because the jobber knows he is able to market goods more economically than any manufacturer, and so long as he can do that he feels assured that his business will not die and his industry will not be lost.

Helping to Find Tenants for the Wired Dwellings

The Union Electric Light & Power Company of St. Louis, Mo., supplies local real-estate dealers with two printed forms which are calculated to keep in service rental property connected to the company's mains. One of the forms is a 14-in. by 21-in. double-faced card which may be posted in the window of an empty building, so that it will show from the outside that the property is for rent, while from the inside its legend informs the intending occupant that prompt electric service connection may be had by telephoning the company's sales department.

THE REVERSE OF THIS DOOR-KEY TAG BEARS THE ELECTRIC-LIGHT COMPANY'S ADDRESS AND TELEPHONE NUMBER

The other form is a double-faced tin-bound tag provided with a twine loop so that it may be attached to the key of an empty house given a prospective tenant for inspection. This tag shows the address and telephone number of the central-station company on one side and on the other carries spaces in which can be noted the number of rooms and rental price of the property, as well as the name of the renting agency with which it is listed.

How a 10 per Cent Commission Boosted One Company's Appliance Sales

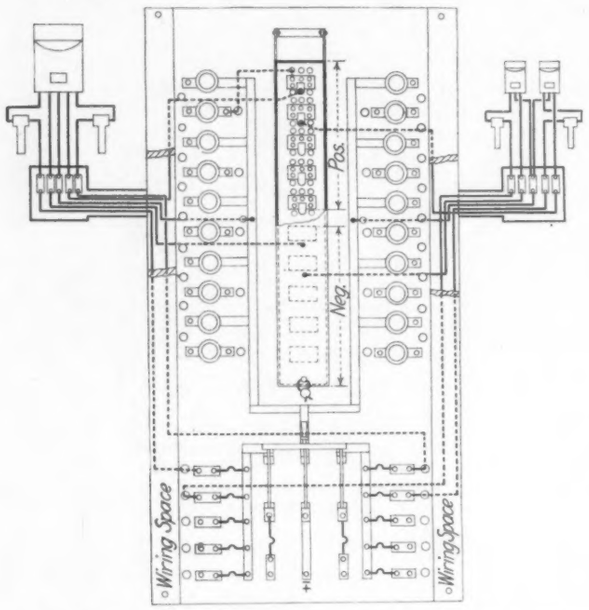
A large New England company whose low level of sales occurred last month nevertheless increased its business more than 200 per cent compared with the preceding year by offering its employees a commission of 50 cents for any device selling at $5, with a percentage increasing from 5 per cent upward acording to the value of the appliance. Outside salesmen are sometimes employed by this company on a 10 per cent commission basis, as well as a bonus award of $1.50 per kilowatt connected. Thus, if the selling price of a flatiron is $2.50, the commission would be 25 cents; the consumption being 500 watts, a further 75-cent commission would be allowed.

Results of a Ten-Day Wiring Campaign

The Colchester (Conn.) Electric Light Company recently ran a ten-day house-wiring campaign, offering to install three outlets, complete with fixtures and 50-watt tungsten lamps, for $14 cash. Practically all of the contracts received during the campaign came in during the last three days, when the company increased the number of its meter customers by nearly 25 per cent.

A Tenants' Thiefless Cut-Out Cabinet

The cut-out cabinet a sketch of which is reproduced herewith differs from the ordinary board in that the connections by means of which an electrician might transfer tenants' circuits from one meter to another are secured in a sealed box. The fuses for main lines and branch circuits, however, are not under seal and



ALTHOUGH THE FUSES ARE READILY ACCESSIBLE, THE CIRCUIT CONNECTIONS ARE SEALED

may be replaced by anyone who has access to the board. When this type of board, which was designed by Nels Joleen of the Commonwealth Edison Company of Chicago, is used, the custody of the seal is generally taken by some of the lighting company's own employees. This thiefless cut-out cabinet can be constructed in a manner that is quite inexpensive.

Safety Stickers on Customers' Bills at Toledo, Ohio

The central safety department of the Doherty companies has been waging a safety campaign particularly directed to attract the interest of children. The method has been to issue a sticker that is affixed to customers'

HELP US TO PREVENT ACCIDENTS
BE CAREFUL FIRST
LET THE CHILDREN HELP ALSO

Don't touch any wire in the street or hanging from a tree or pole.
Don't touch or swing on a street lamp rope.
Don't touch or attempt to fix street lamps; notify the electric company.
Don't climb poles or street towers on which there are wires.
Don't stand under a pole or a tower where linemen are working.
Don't fasten clothes lines or any wires to electric light or telephone poles or towers.
Don't have your hands wet or on any metal in the bathroom when you turn the lights on or off.
Don't go near man holes or trenches in the street even though there are guard rails around them.
Don't throw string or rope over wires.

THE TOLEDO RAILWAYS & LIGHT CO.

TO TEACH THE CHILDREN TO BE CAREFUL

bills. This sticker contains advice against inviting accidents in such ways as by touching fallen wires and other adventures into which juvenile curiosity may lead. A sample of the sticker as used by the Toledo Railways & Light Company is reproduced on this page.

The Electrically Heated Restaurant Coffee Urn

The Sparta Gas & Electric Company, Sparta, Ill., is deriving an income of $3.50 per month from each of two electrically heated coffee urns in service in local restaurants. The electrical equipment of these coffee urns is of home manufacture, ordinary gas-heated urns, according to Cale Gough, manager of the Sparta Gas & Electric Company, having been fitted with electric disk-stove heaters at a cost of about $9 each.

A Profitable Variation of the Usual Temporary Street Festoon —a Plan by Which Each Merchant Contributed to the Distinctiveness of His Own Display

In many towns and cities it has become the custom when a civic celebration of any sort is held for the local central-station company to erect festoons of lamps across the streets from curb to curb. Sometimes the local merchants' association pays for this lighting, and sometimes the central-station company stands the expense and charges it to advertising. But, regardless of the way the details are arranged, the individual merchant generally feels that the benefit to his particular business from the display lighting is insignificant.

Having sensed this feeling, the officials of the Massillon (Ohio) Electric & Gas Company decided to vary the plan for the decorative lighting to be put up for a civic celebration this winter. Accordingly it was proposed to the Retail Board of the Chamber of Commerce that each merchant use streamers of lamps to decorate his store front in any manner which seemed to him most fitting. Stress was laid on the fact that each merchant might use his own individual design for his store. The merchants' board approved the plan and appointed a committee to help the central-station company to get the business.

STORE-FRONT STREAMERS TOOK THE PLACE OF CURB FESTOONS

A total of 6000 lamps was used for the festoons put up on this occasion. and each merchant willingly paid for his part of the lighting. When the celebration was over the merchants reported receipts 25 per cent greater than ever before for the same period.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

High-Tension Cable Tests

The Use of Direct Current for Testing Alternating-Current Cables—Apparatus and Connections Used

WHEN a cable has been laid it is advisable to check by test its dielectric strength, since the measurement of the insulation resistance, for instance, would not permit definite conclusion as to the dielectric strength. With low-pressure cables there is no difficulty, but with high-tension cables and cables of great length the test becomes complicated. The apparent power, and in consequence the dimensions, of the required transformer increase as the square of the testing voltage and directly as the total capacity of the cable, and very soon the dimensions reach such a size as to make transportation of the transformer difficult. It is for this reason that it has been proposed to use direct current for testing high-tension alternating-current cables in position, because apparatus of small power and moderate dimensions can be employed. While during the last few years notices have appeared, chiefly in French and German electrical engineering journals, on Delon's apparatus designed for this purpose, probably the fullest information on this subject is contained in a paper read on Feb. 10, 1916, by O. L. Record before the (British) Institution of Electrical Engineers and published, abstracted, in the London *Electrician* of Feb. 11, 1916.

The principle of the Delon apparatus is indicated in

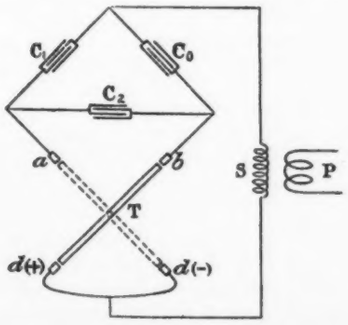


FIG. 1—ARRANGEMENT OF APPARATUS

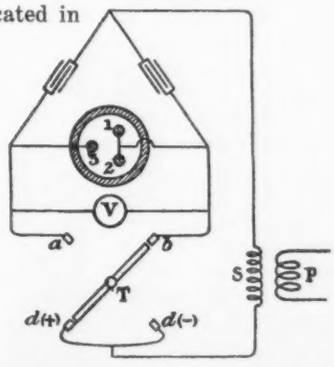


FIG. 2—CONNECTIONS WITH CONDENSERS

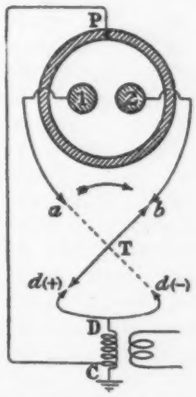


FIG. 3—CONNECTIONS FOR TWO-CORE CABLE

Fig. 1, in which the condenser C_2 represents the cable to be tested. The feature is a high-tension contact maker which charges condensers by making at each half period a connection through a short spark between the transformer and condenser to be charged. By means of a suitable arrangement the contact is made at the moment when the emf. is at its maximum value, and by means of auxiliary condensers the voltage of one-half period is added to that of the other, with the result that finally the principal condenser (or cable) is charged to a pressure double the maximum of the alternating current employed.

The contact maker formed by a conductor T embedded in an ebonite disk revolves round a spindle perpendicular to the plane of the disk. Four fixed brushes are placed a very short distance from the disk in such a manner as almost to make contact with the conductor when the latter passes between them. These four brushes are placed at the extremities of two diameters which are perpendicular to the axis of the disk. Two of the adjacent brushes are joined together and connected to one of the secondary terminals of the transformer. The other two brushes are connected each to an apex of the triangular group of condensers to be charged, the other apex being joined to the second terminal of the transformer.

The disk is driven by means of a synchronous motor fed from the alternating-current circuit which furnishes the high-tension current by means of the transformer. The group of fixed brushes can be placed at a convenient angle to allow of their coming opposite the moving conductor at the moment of maximum voltage. The condenser (cable) C_2 to be charged and the two auxiliaries C_0 and C_1 form a triangle of which the apexes are connected to the brushes a and b and to the transformer.

At the outset, the synchronous motor being started, if the primary circuit of the transformer is closed, the moving conductor T passes, say, first of all between the pair of fixed brushes b and d (+). The condenser C_0 takes a charge which depends on the self-induction of the transformer and the maximum voltage of the secondary current. The other two capacities C_1 and C_2 take a charge such that the sum of their potentials U_1 and U_2 is equal to the potential U_0 of the condenser C_0.

At the following half period it is the condenser C_1 which is directly connected to the secondary, and as the direction of the current is changed this condenser is charged in the same direction as in the previous case. The capacity C_0, on the contrary, receives a charge in the opposite direction to the first. As a result, the capacity (cable) C_2, which is the one that it is desired to charge up to a high potential, receives charges which are always in the same direction whatever the position of the moving conductor. The quantity of electricity supplied at each contact will then charge simultaneously one of the two auxiliary condensers in parallel with the group formed by the secondary auxiliary condenser and the capacity C_2. As the time during which contact is established between the transformer and the capacities is very short, and as, moreover, the self-induction of the secondary of the transformer is considerable, the

quantity of electricity that can be introduced into the system at each half period is limited, but the repetition of the phenomenon is so rapid that at the end of a relatively short time the capacity C_2 reaches a potential equal to twice the maximum pressure of the alternating current. In practice the charging-up is effected in less than a minute of a frequency of fifty—that is, in less than 6000 contacts.

The whole of the apparatus is contained in a handcart, the total weight of which is just over half a ton, so that it is quite easy for two men to handle it. The transformer is furnished with two primary windings, which can be placed in parallel or series, allowing a voltage of 15,000 or 30,000 to be obtained on the secondary with a pressure of 110 volts on the primary side. With this apparatus it is therefore possible to test cables up to approximately $2 \times 30{,}000 \times 1.4$—i.e., 84,000 volts—and by increasing the primary voltage it is possible to test up to 100,000 volts.

With regard to the method of testing, either the two auxiliary condensers can be used, or in the case of multi-core cables they can be dispensed with, one or two of the conductors and the lead sheath taking their place. Fig. 2 shows the connections with the condensers.

Fig. 3 shows the connections for a two-core cable. In this case one of the conductors of the cable is subjected to a pressure always of the same sign and equal to the maximum positive value of the alternating emf., viz., $+E\sqrt{2}$, and the other to a pressure equal to the maximum negative value, viz. $-E\sqrt{2}$, so that there is at any instant between the two conductors under test a difference of potential equal to double the maximum voltage, viz., $2E\sqrt{2}$.

As to the direct-current voltage to be used in the test, the experience of Laporte has shown that a continuous potential will only produce the same break-down effect as an alternating potential of one-third to one-fourth its value, while one would have expected the ratio $\sqrt{2}$ to 1. These are merely the results of laboratory tests, and the author fully recognizes that practical engineers will perhaps only accept them for what they are worth. They are, however, confirmed by other results obtained in practice. "Various objections have been raised to the method. For instance, some engineers think that the causes of puncture of cables are quite different with alternating current from what they are with continuous current. Also that the test gives a false security and that in specifying a continuous-current test new conditions are imposed on the manufacturer, conditions which are quite useless from the point of view of the service for which the cables are required. It appears, however, a simple matter to establish the relation between the alternating and continuous pressures which will produce the same disruptive effect. Objections would disappear if a definite test pressure were agreed upon."

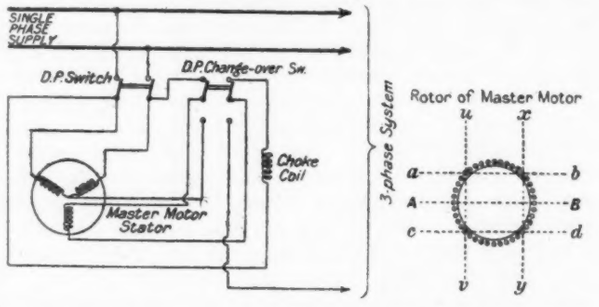
Generators, Motors and Transformers

Currents in the Axles of Dynamo-Electric Machines.—P. GIRAULT.—In the continuation of his former papers on the subject, the author gives the results of a further extension of the mathematical theory on the way in which direct currents are produced in the axles of dynamo-electric machines.—*Bull. de la Soc. Internat. des Elec.*, November, 1915; in abstract in *La Revue Elec.*, Jan. 7, 1916.

Heating of Motors.—MAURICE D'ASTE.—A study of the heating of electric motors or other electrical apparatus in operation. The author first considers the motor as an isothermic body. He then considers the stator and the rotor separately, and investigates how they react on each other with respect to heat. The results are applied to considerations of a motor in operation and curves are developed for a traction motor.—*La Lumière Elec.*, Jan. 19, 1916.

Generation, Transmission and Distribution

Three-Phase Induction Motors Used on Single-Phase Circuits.—M. ROSENBAUM.—In many districts, owing to the preponderance of lighting load during the initial stages of development, the only available supply is single-phase alternating current. The author shows how on such single-phase circuits three-phase motors can be used advantageously so that when later the supply system is changed to three-phase no scrapping of motors is necessary. The method consists in the artificial production of a slightly unsymmetrical and unbalanced three-phase circuit by the employment of what is termed a master motor, this master motor being a three-phase machine acting as a transformer and converting the single-phase supply to a three-phase system. This master motor can at the same time be usefully employed to drive machinery; but just as in the case of a synchronous motor, which can be employed usefully and also to improve the power-factor of a system, so here there is a limit to the output in each case, and the greater demand there is on the motor as a transformer the less power there is available for direct driving of machines. A master motor is essential for the initial production of this artificial three-phase system, but once several



THREE-PHASE MOTOR CONNECTED TO SINGLE-PHASE SOURCE TO MAINTAIN THREE-PHASE SUPPLY FOR OTHER MOTORS

single-phase motors are connected to this system each and every one serves as a transformer, and no one machine need be directly employed for the transformation, the transformer action taking place with those machines which are only lightly loaded directly and supplying those machines which are fully loaded. For this reason, once the system is started, no one machine need necessarily be employed as a master motor, since each and every one can be made to serve in this capacity. It is, however, usual to employ a particular machine for this purpose of a size sufficient for the needs of the network, which, practically, can be assumed to be fully loaded. The master motor consists of an ordinary three-phase machine, the stator of which is shown on the left hand of the cut. This machine is started up as a single-phase induction motor from the single-phase supply. The third phase completes the three-phase supply. The production of the three-phase supply can be explained as follows: At the right of the illustration is shown the rotor of this master motor, which can be divided into two stationary zones of conductors at right angles and bounded by *ab*, *cd*, and *uv*, *xy* respectively. The flux due to the single-phase current in windings 1 and 2 of the stator will be a pure single-phase alternating one along the axle *A-B* at right angles to the third phase. This flux along *A-B* is shown in the right-hand diagram, and has two effects as the rotor revolves. On the conductors in zone *uv*, *xy*, a transformer action takes place. The belt between *ab*

and *cd* is subjected to a rotational effect. These two stationary zones will have emfs. induced in them at right angles to one another, and thus the current flowing will also be 90 deg. out of phase, since the internal characteristics of the rotor for these two zones will be the same. These currents give rise to a rotating magnetic field which, cutting the stator circuit, produces the three-phase supply necessary. A large master motor is advantageous where a fairly high starting torque is required. The author discusses the relationship between the output of the motor as a single-phase machine and when used in conjunction with a master motor and gives load curves. The article is illustrated by numerous diagrams.—London *Electrician*, Feb. 18, 1916.

Installations, Systems and Appliances

The Italian Electrical Industry.—GUIDO SEMENZA.—A brief note on his presidential address before the Italian Electrotechnical Association. Taking as the starting point the fact that the rules and standards of the German Association of Electrical Engineers have hitherto prevailed in Italy, he outlined the history of the native Italian industry and set forth the reasons why, after a brilliant beginning, it had to surrender its arms in face of foreign competition, aided by the expansionist German policy, together with the irrationality of the protection afforded by the import duties and the hostility springing from the fact that Italy in the past had been dominated by the fetish for foreign goods. When the war broke out it was found how profoundly German influence had taken possession of the Italian market, and the association has therefore assumed the task of seeing whether it will not be convenient to promote an agitation so that the electromechanical industry may attain to that development which is its due. The manufactures of the industry are precisely those which utilize hydraulic power, which is to-day a very important branch, as it supplies the Italians with motive power. But serious difficulties stand in the way of progress, including those of the import duties, which, instead of dealing with heavy machines according to weight as at present, ought to be applied on an ad valorem basis. The next duty of the association will be in the direction of endeavoring to persuade the government, the provincial authorities, the town councils and the large companies that it would be appropriate to give a clear preference to machinery constructed in Italy. It is necessary for the machinery and materials to be of high quality and to be able to vanquish foreign competition. There has, however, hitherto been very little co-operation between science and industry in Italy, whereas the German industry had reached its present degree of perfection by the application of science to all industrial processes. The association intends in a short time to issue Italian rules and standards for the construction of machinery, which should have the effect of improving the types made. These rules will be known as those of the Electrotechnical Italian Association, and will be in opposition to those of the German association, if assistance is rendered by the government, the professors, the consulting engineers and the manufacturers.—London *Elec. Review*, Feb. 18, 1916.

Wires, Wiring and Conduits

High-Tension Cables with Zinc Conductors.—LEON LICHTENSTEIN.—Since zinc has come into extended use as a substitute for copper for electric conductors in Germany during the present war, fear has been expressed that in case of a serious short-circuit the zinc conductors may melt or evaporate for a considerable length of line or may deteriorate into an allotropic form of zinc and disintegrate into powder. The author gives results of a series of tests which show that these fears are unwarranted.—*Elek. Zeit.*, Jan. 6, 1916.

Artificial Insulating Materials.—An illustrated article describing briefly various artificial insulating materials made by different companies.—London *Electrician*, Feb. 4 and 11, 1916.

Suspension Insulators.—W. PETERSEN.—An illustrated article on measurement of the distribution of tension over the different portions of a suspension insulator.—*Elek. Zeit.*, Jan. 6 and 13, 1916.

Electrophysics and Magnetism

The Initial Conditions of the Corona.—JAKOB KUNZ.—A brief abstract of an American Physical Society paper giving a description of the numerous phenomena which are connected with the corona discharge. The difference between positive and negative electricity appears in electrical, optical, mechanical and probably chemical effects. The thickness of the luminous layer is shown to be independent of the radius of the wire. A certain amount of energy will have to be accumulated before the luminous discharge appears. This assumption leads directly to the law that the critical electric force at the surface of the wire is inversely proportional to the square root of the radius of the wire. The constants in this relation are different for the positive and the negative corona. By means of the theory of ionization by collision the influence of the pressure can be accounted for. —*Phys. Review*, February, 1916.

Cathode Fall with Glow Current in Hydrogen.—W. L. CHENEY.—Skinner has recently developed a theory of the cathode fall in gases which suggests that with a plane cathode the "normal" current density should be proportional to the square of the gas pressure, provided that the number of mean free paths of the electrons from the cathode to the point of minimum gradient in the negative glow is the same for all pressures. In measurements made with aluminum and steel cathodes in hydrogen both of these conditions were found to exist. The author has extended this investigation to other metals. The "normal" current density at the cathode was measured in hydrogen with aluminum, steel, nickel, zinc and platinum as cathodes, and was found in all cases to be proportional to the square of the gas pressure. The number of mean free paths of the electrons from the cathode to the point of minimum gradient in the negative glow was measured for these metals under the same conditions and found to be independent of the gas pressure.—*Phys. Review*, February, 1916.

Units, Measurements and Instruments

Organization of Scientific Research.—J. A. FLEMING.—A lecture before the Royal Society of Arts in London. The author discusses first the methods of scientific research and the means for conducting such research, and finally deals with the training of research men. He recommends that Great Britain should have a "properly complete scientific intelligence department." The different agencies, committees and institutions which have been endeavoring to supply scientific information as to manufactures should have as their resultant a single organization, the function of which should be to collect and distribute all possible information concerning the mode of manufacture and cost of production and information concerning the patent position, if any, of all the appliances and materials used in scientific research. Such a scientific intelligence and information bureau might need subsidizing at the start, but it might be possible later on to make it self-supporting by the subscription of firms and persons who desired information on particular matters.—London *Electrician*, Feb. 18, 1916.

Selenium Cells.—W. R. Cooper.—The first part of an illustrated article in which a general account is given of the properties of the various varieties of selenium, this being followed by a discussion of the effects of light, the dependence of sensitiveness on wave-length, and the measurement of sensitiveness. In the latter part of the article will be given some account of the theories which have been put forward to account for these facts. In conclusion, some details of construction are to be given and applications are briefly to be described.—London *Electrician*, Feb. 11, 1916.

Telegraphy, Telephony and Signals

Theory of the Coherer.—E. Branly.—A paper on the conductivity of a thin layer of air between two metallic surfaces. It is generally assumed that when a coherer is rendered conducting by electromagnetic waves this is due to the formation of conducting bridges. Various observations have so far prevented the author from accepting this view. He assumes a conductivity proper of the dielectric itself when this is a sufficiently thin layer. Former experiments by him on solid and liquid conductors were in favor of this view. The results of his new experiments appear to show that it is the conductivity of the gas layer to which the operation of the coherer is due.—*La Revue Elec.*, Jan. 7, 1916 (published Feb. 18, 1916).

Miscellaneous

Protection from Roentgen Rays.—A note on a recent discussion before the Roentgen Society in London. Sidney Russ pointed out that although X-ray dangers are becoming less formidable, owing to the more general knowledge of the peril, yet at the same time the neglect of precautions was all the more serious on account of the increasing power of X-ray outfits. The X-ray outfit of the most modern type is capable of fifty times greater power than the ordinary outfit of ten years ago. He and other speakers suggested that certificates of safety should be given with X-ray apparatus. H. E. Donnithorne showed that even protective devices themselves might be a source of danger, instancing a couch which was furnished with a protective metal surface at a certain angle which the X-ray beam was just able to graze. The incident radiation was thereupon increased, and this he attributed to the generation of secondary rays from the metal itself. F. Bailey said that his own practice was to shelter himself behind a large screen, the upper third of which consisted of lead glass, and also to inclose his tube in a large lead-glass bulb. In this way the operator could hardly receive any direct X-rays at all, but he still remained subject to the ionized atmosphere of the X-ray room and its possible dangers. W. Harwood Nutt said that some X-ray workers were returning from the seat of war with very bad ulcers on the arms and hands, and he did not believe that any man could protect himself adequately, however much he was clothed with aprons and gloves, etc., unless the tube also was inclosed. The effects of atmospheric ionization might be overcome by efficient ventilation, using two electric fans, one drawing the air into the room and the other drawing it out. Herschel Harris thought that the great fault was in the glass supplies for protective purposes. It was often not lead glass nor X-ray-proof at all, and the makers should be asked in all cases to notify their customers as to the quality of the glass they supplied.—London *Elec. Review*, Feb. 11, 1916.

Fatal Electrical Accident.—Details of an accident at Eastbourne, England, in which a motor car collided with an electric switch pillar causing the death of two men. —London *Electrician*, Feb. 11, 1916.

Book Reviews

Deutscher Kalender für Elektrotechniker. Edited by G. Dettmar. Munich and Berlin: R. Oldenbourg. 672 pages, 226 illus. Price, 3.50 marks.

The thirty-third annual edition of a well-known and useful pocket-book. Actually, in course of development, the book has reached overcoat-pocket size, and even then it has had to be accompanied by a second section for the shelf as a supplement to the *vade mecum* first-section pocket-book. The subjects dealt with in the pocket-book are the following: Tables, units, magnetism, electricity, measurements, machines, transformers, apparatus, central stations, lighting, motors, public utilities, rules and standards. The book has been carefully prepared and is one of the standard German publications of the electrical engineering industry. Being edited by the general secretary of the Verband Deutscher Elektrotechniker, it is regarded as an annual official organ of that body. The rules for the resuscitation of persons rendered unconscious by electric shock seem to need revision. The advocated method of practising artificial respiration is the old and laborious Sylvester method, which was standard also in America until a few years ago. At present the American method is the more recent, more efficient and much more convenient Schaefer method, standardized by the National Electric Light Association.

Annuaire pour l'An 1916, Publié par le Bureau des Longitudes. Paris: Gauthier-Villars et Cie. 900 pages, illustrated. Price, 1.50 francs.

The present issue of this yearly publication of the Bureau des Longitudes appeals to the wide circle of readers anxious to know the latest results obtained in the various branches of knowledge, whether depending on measurements made in the laboratory or on observations in the observatory. The chemist will find in the present volume tables of atomic weights, specific heat, and density of gases and liquids, as well as of metals and minerals. The students of physics will be glad to refer to some recent work on the electromotive force of primary cells and the dielectric constant of various substances; also to the magnetic chart of France for the epoch of Jan. 1, 1911. M. Deslandres contributes a paper of fourteen pages on the physics of the sun and M. Bigourdan one of eighty-one pages, with forty illustrations, on the mean barometric pressure and the prevailing winds of France. On page 248 reference is made to the discovery by Galileo of four of Jupiter's satellites in January, 1610, to which five others have been recently added, one by Melotte at Greenwich and four others by Barnard (one), Perrine (two) and Nicholson (one) at the Lick Observatory. The number of asteroids registered to date is given as 778 on page 256. An interesting account of the composition of the atmosphere at different altitudes up to 100 km. (63 miles) will be found in M. Bigourdan's paper on barometric pressure.

Books Received

Wireless Transmission of Photographs. By Marcus J. Martin. London: The Wireless Press, Ltd. 118 pages, 62 illus. Price, 2s. 6d.

House Wiring. By Thomas W. Poppe. New York: The Norman W. Henley Publishing Company. 126 pages, 95 illus. Price, 50 cents.

F. A. Darst has been appointed superintendent of the Beloit (Kan.) light and water department.

George F. Quinan has been appointed engineer of the Puget Sound Traction, Light & Power Company, Seattle, Wash., and will head the new engineering department of the company, with L. A. Wallon, S. C. Lindsay and C. R. Collins as assistant engineers.

T. C. McReynolds, secretary-treasurer and general manager of the Indiana Railways & Lighting Company, Kokomo, Ind., has been absent from his office since last October, owing to illness. Mr. McReynolds recently went to Phoenix, Ariz., and is now reported to be improving.

M. C. Rorty, special agent for the American Telephone & Telegraph Company, New York City, who contributes to this issue an article on "Opportunities for Young Electrical Engineers in the Telephone Field" (page 654), has had a varied experience in the electrical and telephone fields since his graduation from Cornell in 1896. After a year with J. G. White & Company as foreman of construction of the first Niagara transmission line, Mr. Rorty entered the employ of the New York Telephone Company, working as an instrument installer, troubleman and wire chief until 1899, when he took up circuit work, factory inspection, development engineering and traffic engineering for the American Bell Telephone Company. During the seven years from 1903 to 1910 Mr. Rorty served with the Pittsburgh Bell Telephone Company as general traffic superintendent, general superintendent, general commercial superintendent and division manager. From 1910 to 1915 he acted as commercial engineer for the American Telephone & Telegraph Company, and in the year following became manager of joint telephone arrangements and assistant to the vice-president of the Western Union Telegraph Company. Mr. Rorty has done much special work in connection with the development of central-energy manual and automatic switchboards, the application of the mathematical theory of probabilities to traffic problems, the development of unit-cost accounting methods, and the establishment of principles of telephone rates.

M. C. RORTY

Men of the Industry

Changes in Personnel and Position—Biographical Notes

E. P. Worden, formerly of the Fred M. Prescott Steam Pump Works, Milwaukee, Wis., has been appointed chief engineer for Henry R. Worthington, Harrison, N. J.

Archer Walser, engineer of the Cia General Electro do Brazil, is in the United States, spending a few weeks at the works of the General Electric Company, Schenectady, N. Y. Mr. Walser plans to return to Rio de Janeiro on April 1.

Edward A. Hanff, formerly with the engineering department of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has accepted a position with the Pennsylvania Electrical & Manufacturing Company, Irwin, Pa., as chief engineer.

P. P. Bourne, formerly chief engineer of the Blake & Knowles Steam Pump Works, East Cambridge, Mass., is again associated with the International Steam Pump Company, in connection with special engineering work, with headquarters at the main office, 115 Broadway, New York.

F. W. Scheidenhelm, who with D. W. Mead has opened a consulting engineering office in the Equitable Building, New York City, has been engaged in private and consulting hydroelectric work in Pittsburgh, Pa., for a number of years. Recently, as vice-president and chief engineer of the Hydro-Electrical Company of West Virginia, he was in charge of the Cheat River developments of that company.

Daniel W. Mead, who with F. W. Scheidenhelm has opened a consulting engineering office in the Equitable Building, New York City, has been in engineering hydraulic and hydroelectric practice about thirty years, during part of which time he was engaged in construction contracting. In later years he has had a consulting engineering office at Madison, Wis., in addition to fulfilling the duties of professor of hydraulic and sanitary engineering at the University of Wisconsin. In 1914, as a member of the board of consulting engineers acting for the American Red Cross and for the Chinese Republic, Mr. Mead spent some months in China investigating the problems of flood control and river regulation along the Huai River. He is also now acting as consulting engineer for the Miami Conservancy District, which is handling the problem of flood protection at Dayton, Ohio. As an author Mr. Mead is best known for his book on "Water-Power Engineering," though he has written a number of other books and many papers on hydraulic and related subjects. He plans to divide his time between Madison and New York.

Howard Walker, formerly a district superintendent for the Ohio Service Company of Coshocton, Ohio, has been appointed to the newly created position of general superintendent of the Ohio Service Company's properties. Mr. Walker will have charge of the operation of all the company's properties in the State of Ohio, acting in the capacity of assistant to C. H. Howell, the company's manager.

Obituary

Robert M. Jones, a well-known hydroelectric engineer of Denver, Col., who died March 1 at Carlsbad, N. M., was a pioneer in the design and installation of central-station, street-railway and hydroelectric plant work in the West. In 1883 at Laramie, Wyo., he built the second Edison three-wire central-station system in the United States, following this with the construction of a number of lighting and railway plants in Western states. An invention of Mr. Jones about 1889 was an electric rotary diamond drill which pierced hard dolomite at the rate of 4 in. per minute. During the 1893 panic Mr. Jones financed and began the construction of the Big Cottonwood Stairs hydroelectric plant to supply power to Salt Lake City. This station contained a number of original features, one of which was the direct connection between the waterwheel and the generator mounted on the same base frame. Later Mr. Jones built the "Jordan Narrows" plant south of Salt Lake City and the plant of the Pike's Peak Power Company, supplying power to Victor and Cripple Creek, Col., an original feature of which was a steel-faced rock-filled dam 100 ft. high. Mr. Jones located, designed and partially constructed the first plant of the Nevada-California Power Company on Bishop Creek, Cal., and in 1903 made the first application of the double-discharge-type Francis turbine in this country in the plant of the Black Hills Traction Company at Spearfish, S. D. Since 1906 Mr. Jones had been in consulting engineering work in the West and in Mexico. He had recently developed a process for making hollow poles, piles and pipe from reinforced concrete.

R. M. JONES

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Single-Electrode Electric Furnaces for Making and Refining Steel

In the ELECTRICAL WORLD of Feb. 5, 1916, there appeared an article entitled "Electric Furnaces for Producing Refined-Steel Products," in which mention was made of the adaptability of electrically operated furnaces for the production of steel castings of superior quality, high-grade steel alloys and tool steel. Two types of Girod furnaces (French make) were also described in this article.

In the halftones printed on this page single-phase single-electrode furnaces made by the Snyder Electric Furnace Company, 53 West Jackson Boulevard, Chicago, Ill., are shown. Of all geometric shapes, a sphere has the largest ratio of volume to surface, and for that reason the Snyder furnace has been made as nearly spherical as possible. Besides, the heat loss by radiation from the furnace is proportional to the outside area of the furnace body. A single central electrode permits the carrying out of the spherical form, and with its central position the source of heat, the company points out, is at the maximum distance from the walls, thus keeping down the refractory consumption. The various types of furnaces made by this manufacturer are designed to make ten heats in twenty-four hours. A furnace designed with an output of 200 tons a day requires a floor area of about 40 ft. square, including the space needed for charging as well as working space.

After the bath is melted there is substantially no difference, it is claimed, in temperature between the different parts. This is said to be due to a considerable extent to the motion of the bath caused by the current, the portion of the bath carrying the current moving so as to tend to increase the length of the circuit, and thus causing the metal to circulate from the back toward the front in the center line of the bath and back again along the sides. The furnaces can be lined with either an acid or a basic material. With a basic bottom refining can be done.

The furnaces are relatively small, and the shell extends all over the body with the exception of the roof. The shell is of steel and varies in thickness from 0.25 in. to 1 in. The shell is laminated so as to give a low radiation loss. The furnace door is made in the form of a plug mounted to swing in vertical trunnions. The door frames are made round so that the brickwork can be built into the form of a self-supporting arch. Furnaces of 0.5-ton holding capacity and larger are rotated by electric motors. Smaller furnaces are rotated by hand wheels. The electrodes are of carbon, either amorphous or graphite.

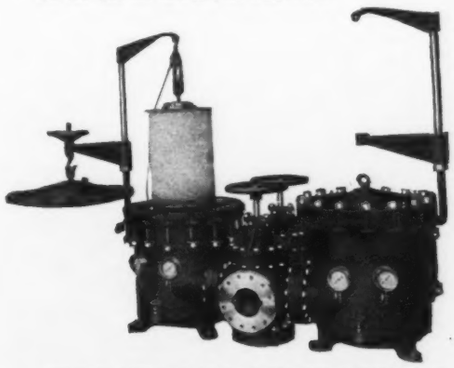
FIGS. 1, 2 AND 3—SINGLE-PHASE STEEL FURNACES WITH RATINGS OF 750 KW., 200 KW. AND 350 KW. RESPECTIVELY*

*The furnace shown in Fig. 1 is one of two 750-kw. electric steel furnaces in the plant of the Otis Elevator Company, Buffalo, N. Y. These furnaces operate between 7 p. m. and 6 a. m., producing from 12 tons to 15 tons of metal apiece per shift with an energy consumption of about 500 kw.-hr. per ton. The furnaces are connected to the lines of the Cataract Power & Conduit Company. In Fig. 2 is illustrated a 200-kw. furnace in the plant of the Niagara Electric Steel Corporation, North Tonawanda, N. Y. This furnace is connected to the lines of the Cataract Power & Conduit Company. The 350-kw. furnace shown in Fig. 3 has been operating for more than two and one-half years at the plant of the Crucible Steel Casting Company, Milwaukee, Wis. It is worked twelve hours a day and produces from 6 tons to 7 tons of steel with energy consumption of about 525 kw.-hr. per ton. The furnace is connected to the lines of the Milwaukee Electric Railway & Light Company.

Filter and Grease Extractor

Filtration of the boiler-feed water is practically a necessity in all modern, economically operated boiler plants, and it is especially important to extract the oil and greases carried over from the main engine cylinders and auxiliaries by the exhaust returns. Effective extraction of oil and greases from water is realized, it is said, only by means of successive filtration through a series of filters, each of ample capacity to permit the comparatively slow percolation of the water through the grease absorbing and extracting medium. To secure such successive or multiple filtration in a filter occupying comparatively small space, the Lagonda Manufacturing Company of Springfield, Ohio, has developed a filter and grease extractor in which the filtering medium consists of a long strip of Terry linen wound in several layers on a large spool, the successive layers being properly separated by a flexible wire mat. The water entering the filter chamber at the top flows down through the perforated core of the spool and filters out in all directions through the successive layers of linen into the spacious spool chamber and the outlet. The

large diameter and length of the spool provide large effective filtering area and maximum capacity of each layer, it is claimed, with minimum resistance to the flow. The filter is a double-unit machine consisting of two complete filters. The two filters are connected by double control valves, thus forming a self-contained unit. Only one chamber is usually placed in service at a time, leaving the other ready to be cut in for use when it becomes necessary to change the spool. There is therefore no interruption in the supply of filtered water, and in time of excessive demand both filters can be cut in in parallel to double the capacity of the machine. Under ordinary conditions the filter cloth need not be removed and cleaned oftener than every ten or fifteen days. The necessity for cleaning is indicated by the difference in pressure on the inlet and outlet side of the filtering material as indicated by the gages. This pressure difference increases as the filtering material becomes clogged, and cleaning is advised when a difference of 10 lb. or 12 lb. is reached.



FILTER AND GREASE EXTRACTOR WITH ONE CHAMBER OPENED FOR CLEANING

To facilitate cleaning, the covers of the filtering chambers are provided with hinged slot bolts and each chamber with a double-arm lifting davit mounted on ball bearings. When the cover bolts are loosened the cover can be easily raised and swung aside by the lower davit arm. The filtering spool is then lifted out by the self-locking block tackle suspended from the upper davit, as shown in the accompanying illustration. Each machine is furnished with a complete extra spool. To further increase the ease of cleaning and handling, a specially designed winder is furnished for unwinding and winding of the filtering cloth and spacing mat on the spool. In removing the filter cloth the spacing mat is wound on the lower spindle, and in rewinding the linen strip is held between two rollers to insure a smooth and tight winding. The strip of linen may be easily washed.

Guy-Wire Protector

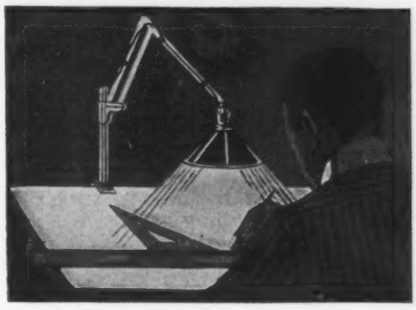
A device for covering guy wires and protecting passers-by who may accidentally run into them is shown in the accompanying illustration. The "Bierce" guy-wire protector, as it is called, is designed to take the place of pipe, wooden boxes, posts stuck in the ground, etc., which are often used for the purpose. The device is made of heavy-gage steel formed into a half circle as shown. It is 7 ft. long, weighs 12 lb. and is provided with two clamping devices 18 in. from each end for

SECTIONAL VIEW SHOWING CLAMPING DEVICE

attaching to the guy wire at any point desired. One clamping device on the protector is provided with a bolt 1 in. longer than the other, thus enabling the longer clamp to be clamped over the rod, if desired, while the other clamp can be attached to the guy wire in the usual manner. The protector is said to be neat in appearance and presents sufficient surface to be plainly visible from all sides. The length, it is claimed, is sufficient so that the top of the protector will be above the level of a man's head even when the bottom of the protector is near the ground level. The protector may be easily installed and can be used for a very long time. It is finished in a light-gray color and made by the Specialty Device Company, 112 West Third Street, Cincinnati, Ohio.

Adjustable Arm for Lighting Fixtures

An adjustable arm with a parallelogram attachment which is designed for use with incandescent lamps for throwing the light in practically any direction desired has been developed by the Universal Appliance Company, Worcester, Mass. No thumbscrews are employed, and the manufacturer claims that the arm stays exactly where it is put. The mechanism works very easily. There is a friction screw in the back of the device for taking up as much as a year's wear by a slight

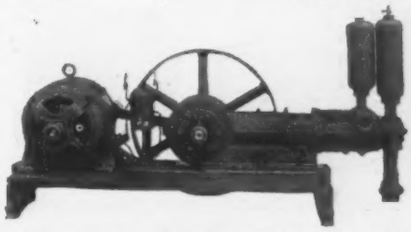


ADJUSTABLE ARM CLAMPED TO DRAWING TABLE

turn, or for adjusting the arm when a very heavy shade is being employed. With this device the light can be adapted to the individual need in practically every instance, eliminating most of the ill effects of improper artificial lighting. The fixture may be finished in old brass, nickel or bronze, and may be equipped with parabolic or "Emeralite" shades. The device may be equipped with a base, clamp, wall-bracket flange or a floor stand, and is especially convenient for use with lamps for reading, drafting or typewriting.

Motor-Driven Double-Acting Pump

An electrically operated pump of the double-acting differential type with two valves and leather-packed piston and stuffing box is shown in the accompanying illustration. The pump is brass-fitted and, according to the manufacturer, is of simple but efficient design requiring practically no attention or care. The frame is of the fully inclosed center-crank engine type. The pump itself is a self-contained unit placed on a rigid bedplate which is mounted on brackets to bring the belt wheel above the floor, eliminating the necessity of a pier or elevated foundation. Lubrication is entirely automatic. On suction heads up to 20 ft. the pump is self-priming. This self-priming feature permits the use of a simple air cock for charging air into pneumatic tanks against any ordinary pressure, making attached or independent air compressors



ELECTRICALLY OPERATED SELF-CONTAINED PUMPING OUTFIT

entirely unnecessary. The automatic electric controller is mounted on the bedplate and connected to the pump and motor, forming part of the self-contained unit. For open-tank service the motor is controlled by a float switch in the usual way. In either case a constant supply of water, the manufacturer claims, of desired pressure is automatically maintained by the pump. The pump is being made by the Fort Wayne (Ind.) Engineering & Manufacturing Company.

Automobile Lighting Switches

The lighting switches shown herewith have been designed particularly by the Connecticut Telephone & Electric Company, Meriden, Conn., for use with automobile electric-lighting systems. The three-gang type N lighting switch, as it is called, shown in Fig. 1, is utilized primarily for lighting, since pulling out the button closes an individual circuit and pushing it in opens the circuit. The switch is provided with a common busbar for battery wires. The mounting plate is 1 11/16 in. by 2 13/16 in. The type ND universal lighting switch, as it is called, shown in Fig. 2, can be utilized for series dimming or to control head and side lamps or large and small bulbs

in head-lamps. In both cases one button puts "on" or "off" the lamps of the car, including the tail-lamps. In series dimming the other button throws the lamps from multiple to series wiring,

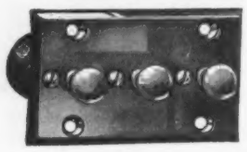
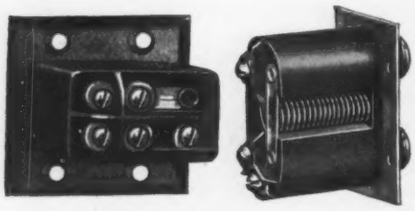


FIG. 1—THREE-GANG LIGHTING SWITCH

thereby dimming. When the system is wired so that one can select either one of two sets of lamps, the position of the second button determines whether the head-lamps or the side-lamps are lighted, or with two-bulb head-lamps whether the large or the small bulbs are lighted. A type C resistance dimming switch is illustrated in Fig. 3. It is a two-gang switch cast en bloc and has incorporated in it a resistance coil for dimming purposes. By pulling out one button the head-lamps and tail-lamps are placed in circuit; the circuit is closed when the button is pushed in. The position of the second button, however, determines whether the head-lamps are burning full or the current is

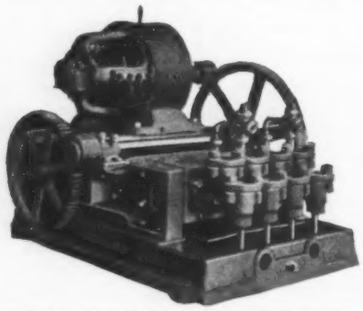


FIGS. 2 AND 3—LIGHTING AND DIMMING SWITCHES

being choked by the resistance coil, thus dimming the lamps. The advantage of this switch, the manufacturer asserts, is that it can be installed without any change in the wiring on the car for dimming purposes.

Oil-Pressure Pump for Electrical Machinery

Builders of electrical machinery and consulting and contracting engineers will be interested in a motor-driven



MOTOR-DRIVEN OIL-PRESSURE PUMP

pump designed especially for forcing oil under the bearings of electrical machinery which has recently been placed on the market by the Goulds Manufacturing Company, Seneca Falls, N. Y. This pump, designated as a "1673" machine, is of the single-acting quadruplex horizontal type, with 7/8-in. cylinders and stroke of 4 in. It has a rating of 2 gal. per minute against a pressure of 1200 lb. The base of the pump is built with a self-contained reservoir of 10-gal. capacity, to which the oil returns from the bearings. The pump is equipped with brass-lined cylinders, plungers of hardened tool steel, bronze crossheads running in bored guides, forged-steel crank shaft, and cast-steel connecting rods, babbitted on the crank end and bronze-bushed on the crosshead end.

Motor-Driven Garage Pump

A neat little air-compressor outfit designed for use in private or other small garages is shown in Fig. 1 mounted on a shelf, where it is out of the way. The air pump is operated by a 1/6-hp. Emerson motor through spur gears which

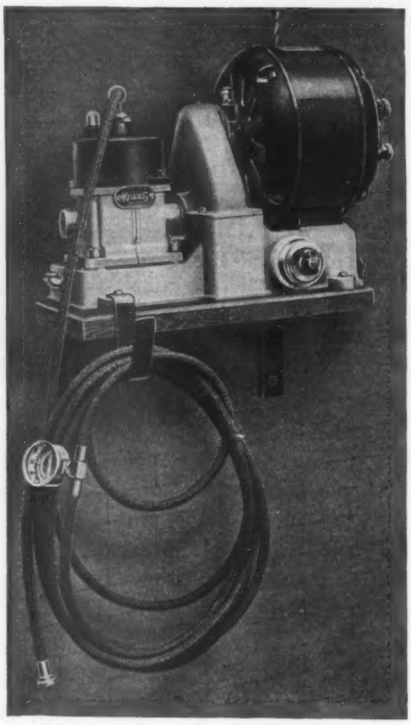


FIG. 1—GARAGE PUMP MOUNTED ON SHELL

are inclosed and run in an oil bath. An oil reservoir is provided and contains sufficient oil, it is pointed out, to lubricate the pump for several months, the gears maintaining a constant level in the pump. The equipment also includes 10 ft. of cord with lamp-socket plug, a four-pole snap switch, 15 ft. of special air hose, and a gage to show the pressure in the tire while it is being inflated.

In Fig. 2 is shown another interesting electrically operated outfit which is portable and is provided with a tank as shown. According to the manufacturer, with this device the air can be taken to the car rather than the car to the air, thus doing away with risk of damaged lamps and fenders. The outfit consists of a four-cylinder pump, a 0.5-hp. Emerson motor, a 14-in. by 30-in. tank designed for a maximum pressure of 400 lb. per square inch and a working pressure of 200 lb., and an automatic cut-out device.

FIG. 2—PORTABLE GARAGE PUMP

The pumps described above are being placed on the market by the Kellogg Manufacturing Company, Rochester, N. Y.

Electric Heater Stoves

Several types of attractively finished electrically operated heater stoves are being placed on the market by the Stoneware Electric Stove Works, 136 Liberty Street, New York. These stoves are made of asbestos and soapstone, these materials, as is well known, being good heat insulators and shedding the heat generated in an upward direction. In Fig. 1 is shown a stove of the casserole type which is provided with a handsomely embossed nickel-plated frame with removable nickel-plated top and two-heat push-button switch. It may be used either in kitchen, bedroom or dining-room for cooking, boiling or for heating a room. The heater is designated by the manufacturer as a class A device. The class B "Little Giant heater stove," as it is called, shown in Fig. 2, is provided with a body of pressed asbestos or asbestos stone. The heating element is surrounded by high-heat porcelain. The stove is designed to boil water in a few

FIG. 1—ELECTRICALLY OPERATED STOVE OF CASSEROLE TYPE

minutes and is also well adapted for toasting bread. It will raise the temperature of an average room 25 deg. Another electric cooker, designated by the manufacturer as a class C device,

is made of cast asbestos cement, which can be of any color desired, the stock colors being black and white. According to the manufacturer, it will do all kinds of cooking, from preparing eggs

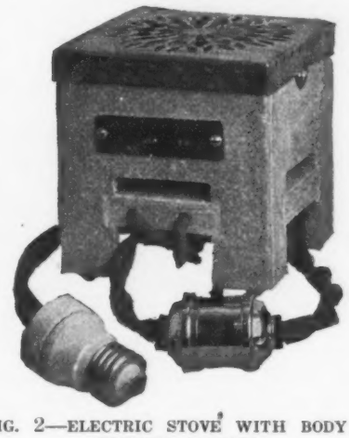


FIG. 2—ELECTRIC STOVE WITH BODY OF PRESSED ASBESTOS

to making pancakes. The class A stove is 7.25 in. in diameter and 4.625 in. high, and takes 6 amp. The class B heater is 4.125 in. high and 4.5 in. square, and with four-heat switch takes 1 amp. to 6 amp., with two-heat switch 3 amp. to 6 amp., and with a single-heat switch 5.5 amp. The class B heater is 7.75 in. in diameter and 4 in. high; with a four-heat switch it takes from 1 amp. to 6 amp., with a two-heat switch 3 amp. to 6 amp., and with a single-heat switch 6 amp.

Small Hydroelectric Generator

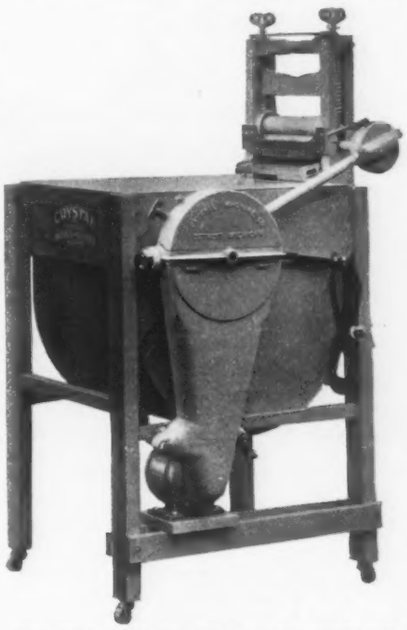
A small toy generating outfit operated by a water motor which can be connected to an ordinary faucet in the same manner as a hose is shown herewith. The dynamo is directly connected to the motor. The motor is provided with a ⅛-in. nozzle and with a water pressure of 80 lb. per square inch develops ⅛ hp. The dynamo is designed for a load of 4 amp. and to operate on a pressure of 6 volts. The outfit should be of especial interest to boys for elec-

SMALL HYDROELECTRIC GENERATOR ATTACHED TO FAUCET

troplating, charging storage batteries and operating lamps, trains of cars, induction coils, etc. All that is necessary is to attach the motor to any faucet where the pressure is 60 lb. or more and then turn on the water. The complete weight of the outfit is 10 lb. It is being placed on the market by the W. N. Manufacturing Company, Manchester, Conn.

Electric Washing Machine

Although the electrically operated washer shown herewith is of the cylinder type, the cylinder does not reverse. The cylinder is so worked, however, that the clothes are raised out of the water and dropped back into it continuously, taking free suds, air and steam with them. The action combines the tumbling process with the advantages of the vacuum process, and gives the washer, it is claimed, a distinctive cleansing power. The cylinder is of special construction, and owing to the elimination of the reversing feature a considerable saving in maintenance is obtained. Every moving part in the mechanism of the washer is entirely



ELECTRIC WASHER WITH NON-REVERSING CYLINDER

inclosed. The wringer can be swung down out of the way, leaving the machine with a flat top so that it can be utilized as a stand when not being employed for washing. The machine is operated by a Westinghouse splash-proof motor, which is fully protected against moisture, at the same time having provision for ample ventilation to insure cool running. There are no exposed electrical contacts, so that the motor, as well as all working parts about the machine, is protected. The washer is being placed on the market by the Crystal Machine Company, Detroit, Mich.

Insulated Wire

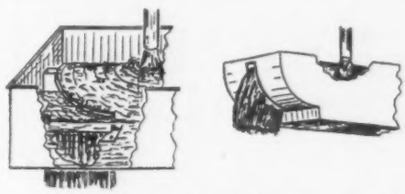
The A A Wire Company of Newark, N. J., has recently brought out what it calls an "intermediate wire," this being a grade between the new code wire and wire containing 30 per cent Para rubber. The rubber compound covering the wire is red, making it easily distinguishable from the ordinary grades, which are usually black. The compound, while clinging suffi-

WIRE WITH RUBBER INSULATION COLORED RED

ciently to the conductor, the manufacturer claims, peels easily, leaving the conductor clean and bright. It has a high tensity, running 50 per cent above the new code requirements, it is pointed out, and will show a "stretch" also 50 per cent above that required by the code. Every coil of No. 14 wire is given a potential test of 3000 volts, alternating current, while the other sizes are subjected to tests in proportion. The code test for No. 14 wire is 1500 volts. The outside covering is of a waxy moisture-proof material, having a high polish, so that the wire can be handled without staining the hands.

Weir That Discharges Fluid at Rate Proportional to Head

A form of weir has been designed recently which will discharge fluid at a rate said to be exactly proportional to the head. Since other forms of weirs, including rectangular and V-notch types, discharge at a rate proportional to some root of the head, this new weir has numerous applications in central stations for measuring feed water, etc., and in hydroelectric plants for ascertaining the flow of rivers, water consumption of turbines, etc. As indicated in the accompanying drawings, the weir may be formed by cutting a rectangular slot in a piece of sheet metal and bending it so that a cross-section forms a semi-cycloid. Another method of making the weir is to construct a metal flue or conduit with a rectangular cross-section and cut one end to the shape of a semi-cycloid. The longer dimension of the flue's cross-section should have at least one and five-eighths times the variation in head which may be expected and the depth of the cycloid should be at least as great as the variation in head. Whichever form of the weir is used,



WEIRS DESIGNED TO DISCHARGE FLUID AT RATE PROPORTIONAL TO HEAD

the base of the cycloid should be placed uppermost and horizontal. This shape of weir has been developed by the Kennicott Company, Chicago Heights, Illinois.

Adjustable Bowl Hanger

The ornamental "Clampall" hanger, as it is called, shown herewith, is designed for use with various types of lighting glassware, and is provided with a detachable arm for outside lighting, as shown in Fig. 2. The inside piece of

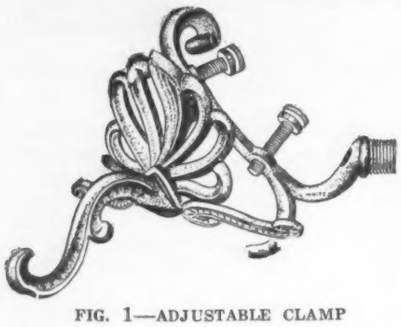


FIG. 1—ADJUSTABLE CLAMP

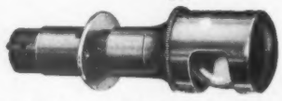
the hanger is hinged at the center and kept in position by the set screw bearing against the top of the ornament, thus adjusting it to the various curves and thicknesses of glassware, insuring a perfect fit, it is declared, and keeping the ornament upright and the arm in correct horizontal position. To provide against shifting, the device has been given a liberal spread of bearing surface at the lower ornate part that hooks under the lip of the glass. The lower screw is employed in case of hemisphere fixtures, and the upper when the device is used with the mushroom types of bowls. It is not necessary to bend any part of the hanger to conform with the curves of the glass. The larger ornate portion of the hanger extends above and breaks the monotony of the straight upper line of the bowl, it is claimed, and, being above, does not destroy or

FIG. 2—CLAMP WITH ARM FOR OUTSIDE LIGHTING

detract from the design of the glass by covering it. The hanger is being placed on the market by the J. H. White Manufacturing Company, 111 North Third Street, Brooklyn, N. Y.

Combination Dash and Trouble Lamp

A type TD combination automobile dash and trouble lamp is shown herewith. It is designed primarily for use as a dash lamp, but can be removed from the dash socket and be employed as a trouble lamp by means of an extension cord. The cord is 10 ft. long and is fitted with proper fittings for attachment to the lamp and socket. By revolving the lamp it may be turned off



COMBINATION AUTOMOBILE DASH AND TROUBLE LAMP

and on. The lamp is provided with a collar and side-spring tension to prevent rattling. Its length from dash to center of bulb is 1 11/16 in. The lamp is being placed on the market by the Connecticut Telephone & Electric Company, Meriden, Conn.

All-Gear Motor Drive for Cone-Pulley Lathes

An all-gear motor drive for cone-pulley lathes with which a motor having a 1:6 speed ratio is used has been developed by the Reliance Electric & Engineering Company, Cleveland, Ohio. With this drive no second back gear

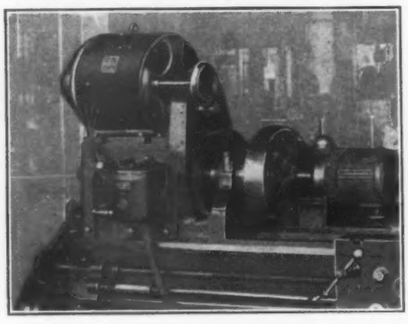


FIG. 1—ALL-GEAR MOTOR DRIVE FOR LATHES

is required; by changing the existing back gear ratio from 1:10 to 1:6, a range of spindle speeds is obtained without a break or objectionable gap. The outfit is designed only for direct current at pressures of 115 volts, 230 volts or 555 volts. Speed changes are made by turning a hand wheel within convenient reach of the operator over the face plate of the lathe. An automatic starting panel of the series current-limit type is employed with the outfit, and it prevents reverse of the motor, it is asserted, even by unskilled operators. It may be placed on the wall, on a nearby post, or in an inclosed case on the back of the lathe. The starting switch is of the drum type and is usually installed at the headstock. Quick stopping is provided by means of a dynamic brake. By using a motor and single back gear, each having a 1:6 speed ratio, the ratio of the minimum spindle speed with back gear in to the maximum spindle speed with back gear out becomes 1:36. The drive can be designed for any desired range of spindle speeds having this total ratio, provided that the range falls within the limits of a practicable gear reduction from motor to spindle. All gears are machine-cut. In Fig. 1 is

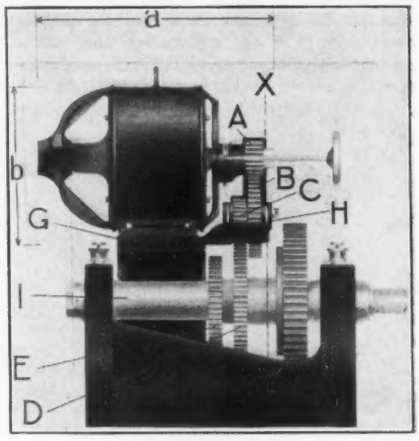


FIG. 2—SIDE ELEVATION OF ALL-GEAR MOTOR DRIVE

shown an all-gear drive for application to cone-pulley lathes. In Fig. 2 is shown a side elevation of the outfit with front side supporting casting removed. The equipment includes motor, starting panel, drum-type operators' switch, giving start, drift, dynamic-brake and reverse control, motor base casting *G* (Fig. 2), intermediate shaft *H* and gears *A*, *B* and *C*, all mounted on base casting *G*.

Light-Diffusing Fixture for Gas-Filled Lamps

An "eye-shield-diffuser," as it is called, has been developed by the Luminous Specialty Company, Indianapolis, Ind., particularly for use with gas-filled lamps for reducing glare. The device is made for all forms of gas-filled units. It can be installed in any fixture in use, the manufacturer points out, and is provided with a holder which slips over the lamp base. The diffuser can be easily snapped on the holder. The device is designed to give an even distribution of light. It is being made

LIGHT-DIFFUSING UNIT

in seven different types to take care of the various kinds of lamps employed. The manufacturer claims that it can be utilized with any existing installation of shades or reflectors. Special types of reflectors have also been developed by the above-named concern for use with the fixture.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Supreme Court Decision in Non-Metallic Flexible Tubing Case

The Supreme Court of the United States on March 6 handed down a decision refusing a petition for a writ of certiorari made by the Tubular Woven Fabric Company of Pawtucket, R. I.

An infringement suit was brought by the National Metal Molding Company of Pittsburgh against the Tubular Woven Fabric Company, the manufacturer of the non-metallic flexible tubing or conduit known as "duraduct." As announced in the ELECTRICAL WORLD, Dec. 11, 1915, the Circuit Court of Appeals of Boston decided that "duraduct" was an infringement of the Osburn patent owned by the National Metal Molding Company. The defendant thereupon petitioned the Supreme Court of the United States asking for permission to reargue the case before that court. The United States Supreme Court refused that petition, so that the decision of the Circuit Court of Appeals stands as a final adjudication. A perpetual injunction will therefore be issued by the judges of the Court of Appeals.

The Tubular Woven Fabric Company will, of course, obey the court mandate and cease infringing the Osburn patent. It has advertised to the trade that it will continue to manufacture "duraduct," stating that it has evolved an improved conduit construction, not amenable to the Osburn patent restrictions, whereby the tube is made entirely of high-grade cotton yarn, permitting the compounds to permeate the tube. Both the single interwoven wall and the roller-bearing wireway will be retained in this new construction.

Montana Power to Start New 40,000-Kw. Development

Although there was placed in service during 1915 50,000 kw. of additional generating equipment in the Great Falls and the Thompson Falls developments, and although the remaining 40,000 kw. will be installed in these developments in a few months, the Montana Power Company has so increased both its present and future business as to make a further development of power necessary. John D. Ryan, president of the company, says in this connection:

"The rapid increase of the business of the company during the year 1915 has taken a considerable portion of the equipment of the new plants brought into commission during the year. This, together with new contracts and prospective business which is assured, has made it imperative that another new development shall be started at once and, if possible, shall be in commission by the end of 1917. The Holter site on the Missouri River, upon which considerable work was done some years ago, being the best site with respect to the distribution and in condition for quick development, has been selected. This development will be for about 40,000 kw. The substation at Anaconda has been enlarged and its rating increased from 10,000 kw. to 20,000 kw. The rating of this station will be further increased during 1916 by an additional 10,000 kw. to 15,000 kw."

Transportation Arrangements Made for N. E. L. A. Convention

What are practically the final arrangements for transportation to the annual convention of the National Electric Light Association to be held in Chicago during the week beginning May 22 were decided at a meeting of the transportation committee held in New York last week.

Two special trains will leave from New York City, the "red special" via the New York Central line and the "pink special" via the Pennsylvania. There will also be a "purple special" to the convention starting from St. Louis, Mo.

Announcement was made at the meeting that the ten or twelve passenger associations in the country had made arrangements for special railroad fares to Chicago for those wishing to attend the convention.

New England Section Question-Box Convention

Nearly 200 members and guests of the New England Section of the N. E. L. A. attended the annual question-box convention of the organization at Boston, Mass., March 7 and 8. A wide range of commercial and operating topics was discussed, with special emphasis upon campaigns to develop electric-range business, miscellaneous motor applications, gas-filled-lamp service and concentric wiring. The annual convention of the section will be held at the Hotel Aspinwall, Lenox, Mass., Oct. 17 to 20 inclusive.

Buffalo Steam Plant Necessary

The Buffalo (N. Y.) General Electric Company has applied to the Public Service Commission for approval of an issue of $3,625,000 of securities, with the proceeds of which it intends to pay for the large plant for the generation of electricity by steam under construction in the town of Tonawanda. Fourteen acres of land has been acquired, and Stone & Webster have started on the construction contract. In the company's application it is stated that this steam plant is a necessity because it can get no further Niagara power and may soon be deprived of some of the power now obtained there. It says the growth of business in Buffalo and vicinity makes it imperative that the plant, or at least part of it, be in operation this year. Of the $3,625,000 cost of the plant, $1,174,000 will be provided by a proposed issue of common stock and the remainder by an issue of the company's 5 per cent first refunding mortgage bonds. The application is accompanied by a statement from a bond broker that these bonds can be sold at 97.

Engineers to Canvass Nation's Resources

The industrial preparedness committee of the Naval Consulting Board opened permanent headquarters Tuesday in New York City. Howard E. Coffin, the chairman, will direct the work of the committee, which is national in scope and calls for the employment in the service of

the nation of about 30,000 engineers in the various States. It is the intention of the committee to assign an engineer to every plant in this country the equipment of which is such that it can be used in the manufacture of munitions or other supplies that would be needed by the fighting services in the event of war.

The forty-eight State boards, which are to operate under the direction of the national committee, have been planned, and the names of the members of each of the boards, it is expected, will be announced shortly. On each board will be a representative of the great engineering societies. The chief work of these State boards will be to take an industrial census of their various States to ascertain what the plants can do in the way of turning out war supplies in the event of a national crisis.

"Future of Concentric Wiring Here Depends on Central Stations"

R. S. Hale in New England "Question-Box" Convention Also Points Out that Use of Bare Concentric Conductor in England Alone Now Totals $2,000,000 a Year

R. S. Hale of the Boston Edison company addressed the "question-box" convention of the New England Section, N. E. L. A., at Boston, Mass., March 7, upon the significance of the concentric-wiring movement. This is, he said, primarily a central-station development, for manufacturers who are meeting outlays for the commercialization of the system are confronted by the absence of basic patents and can only work in anticipation of a general benefit to the industry resulting from lower-cost wiring. From now on the future of concentric wiring in America is a function of central-station enthusiasm. The manufacturers are doing their part, the insurance authorities having the custody of the code in hand for recommendations are displaying open minds, and it is clearly "up to" the central station by trial installations allowed by local inspectors to establish the successful use of this material.

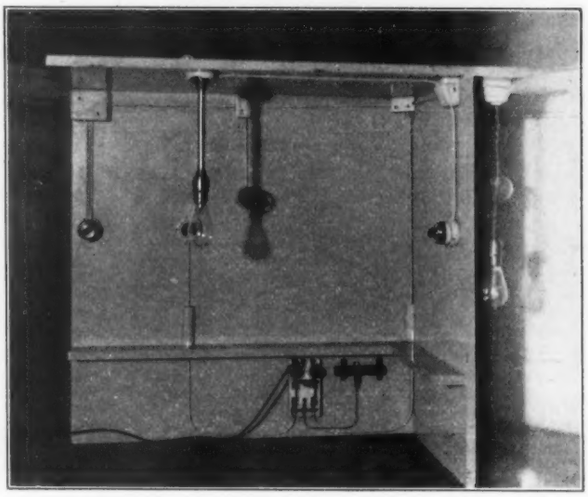
Trial Installations Urged

Both wiring and the fittings developed for use with it are bound to become cheaper with increased use in reasonable quantities. The central station must work hand in hand with the local inspector in making trial installations and cannot as yet expect to be authorized to use this material on a large scale. The first installation is bound to be relatively expensive, in comparison with the cost of present wiring methods, but facility in the use of the material is rapidly acquired by journeymen. Even in the pioneer installations at Boston, which involved the use of "twist-ons" instead of the fittings now available (see the accompanying halftone of sample installation exhibited at the convention), the cost rapidly decreased in the period between equipping the first and the third house. "If you central-station men all sit back and say, 'Let George do it,' however," said the speaker, "we shall not get the results desired. We cannot believe that the Underwriters will turn down a system which is now being installed in England to the extent of $2,000,000 a year, and which is used extensively in Italy and Germany."

No. 14 B. & S. wire has so far been employed in American samples. No circular loom is required in installing concentric wiring. By going first to the local inspector or to the local representative of the Underwriters the central station should have no difficulty in getting permission to make trial installations in 99 per cent of the cases. If the local authorities hesitate, let the central-station man mention that such men as J. C. Forsyth, Washington Devereux, Dana Pierce, A. M. Paddon, George S. Lawler, James R. Strong, H. R. Sargent and W. H. Blood, Jr., approve the use of this material.

Present High Cost Incidental to Development

The wire now developed will carry from 14 amp. to 15 amp. satisfactorily, and for the present must be installed exposed. Papering over the grounded outer sheath is likely to become general later. Abroad a channel about 0.25 in. deep is often cut in the wall for such wiring by a special tool. In Europe the labor cost



SAMPLE INSTALLATION OF CONCENTRIC WIRE AND FITTINGS

was soon cut to 25 per cent of the former outlay by the use of this material. The central station must take the present relatively high cost, about $22 per 1000 ft., with composure, since this is incidental to its development on a free-from-patents basis and is sure to be reduced with more extended use. It is said that it actually costs the General Electric Company $50 per 1000 ft. to make concentric wire at present. Ten houses have been wired at Baltimore and two houses at Chicago, besides those at Boston. (See Electrical World, Oct. 9, 1915.)

A Tentative Set of Rules

W. H. Blood, Jr., of Stone & Webster, Boston, pointed out that a tentative set of rules for the use of concentric wiring is now under consideration by the National Fire Protection Association's code committee. Like the preceding speaker, he felt sure that the cheapening of the cost of material and labor is only a question of time. Mr. Blood, in closing, discussed the safety of concentric wiring, and said that with such an installation one could stand in a bathtub partly filled with water and with one hand grasp the sheathing of the wiring circuit without the slightest hazard. Various forms of sheathing are being worked out by the different manufacturers, and at present no particular type seems superior to the others. The danger of crossed wires is eliminated in interior installations where concentric wire is used.

In closing the discussion, Mr. Hale said that if concentric wiring were a monopoly the central-station industry would be obliged to pay the development cost later instead of now. The first house in Boston was wired at a cost two or three times the standard expense for "BX" concealed work, but the third house was wired at only 15 per cent excess cost. Had the latest fittings been available this outlay would doubtless have been less. The insulation is standardized for 600 volts, and the wire is well protected against moisture, corrosion or rubbing.

Public Service Commission News

District of Columbia Commission

The rules of procedure of the Public Utilities Commission of the District of Columbia have been amended by the addition of the following order on the filing of rates:

"Each public utility shall file with the commission schedules showing all rates, tolls and charges which are in effect at the date of filing and all rules and regulations that in any manner affect the rates charged or to be charged for any service, such schedules to be printed or typewritten upon blank forms to be furnished by the commission and to be filed in triplicate. Each schedule and each rule, regulation, special clause or rider of a schedule shall be numbered or lettered to permit ready reference.

"When any rate, tariff or rules and regulations affecting any rate or tariff of any public utility are changed, the utility shall file with the commission within ten days after receipt by it of the order or permission to make such change a revision of all the schedules affected, such revisions to be filed in triplicate."

There follow rules for the forms, letters, etc., to be filed.

Pennsylvania Commission

In dismissing the objections filed by the Duquesne Light Company against approval of a franchise ordinance between the West Penn Electric Company and Jefferson Township, Allegheny County, the commission says: "In view of the very meager amount of business developed in Jefferson Township by the protestant since it first entered that territory in 1901 it could hardly be maintained with any show of reason that the approval of the contract ordinance would seriously affect the present or future business prospects of the protestant company within the township."

Colorado Commission

The application of the Colorado Springs Light, Heat & Power Company for a rehearing of its rate case, which was decided by the Public Utilities Commission of Colorado in December and reported in the Jan. 8 issue of the ELECTRICAL WORLD, has been denied, but the commission has modified the former order somewhat.

The commission held that under the law its duty in fixing rates to be charged by a utility is to establish just and reasonable rates which shall be applicable to all consumers and purchasers under like conditions, although to do so may abrogate contracts entered into between the utility and its consumers whereby discrimination is effected. It is a presumption that contracts between utilities and their consumers are within the scope of the right of regulation, unless the contrary has been expressly set forth, and the State is empowered to regulate and abrogate contracts which purport to cover rate regulation. The fact that a contract is involved in no respect alters the right of the commission to revise rates, unless the constitution or the Legislature of the State has expressly delegated to the municipality the power to contract inviolably for rates for the period covered by the franchise.

The commission found no authority or precedent for combining gas, electric and water properties as one when they were in no way physically connected and where to have combined them as one would have compelled the patrons of one class of service to help maintain the other. The same was held true for the steam-heating properties, although here it was found to be difficult to separate always this property from the electric property.

The commission further held that a public utility is not subject to the general law of competition, and that its position is entirely different from that of a private concern, in that its service must be continuous, uninterrupted and adequate and should be supplied at the lowest reasonable cost, and the commission, in fixing reasonable rates for utilities, should, after arriving at the present fair value of the property, permit the utility to earn a fair rate of return upon that present fair value, which should be in excess of a proper annual depreciation reserve to be set aside by the utility under the direction of the commission, if the rates thus made are not in excess of the value of the service.

One of the great underlying dangers of state regulation, it was stated, is the attitude of public-utility corporations favoring large intangible values for the purpose of presenting a large paper property valuation.

The commission prescribed an annual sum of $52,000 to be set aside by the utility as an annual depreciation reserve on the company's hydro and electric properties, the value of which was fixed at $1,481,762, and an annual sum, $20,000, to be set aside by the utility as an annual depreciation reserve on its gas property, the value of which was fixed at $710,917. One of the important tests used by the commission in arriving at the fair value was reproduction cost less depreciation, but the commission was unable to settle on any one test which should be the sole basis of arriving at a sum of money upon which the utility should be permitted to earn a fair rate of return.

The commission found that the book value of the property taken over by the consolidation of the three companies forming the present company was $4,666,-968.25 on June 30, 1910, and $4,887,183.77 on June 30, 1915, of which approximately $1,000,000 was found to be intangible values or watered stock, and that as the property of the previous companies had been acquired through bonds and stocks and the retirement of indebtedness, the discounting of which and the value of the stocks not being shown, but they being carried at par value on the book accounts, the book value might be further reduced. It was found to be impossible to determine what amount of the remaining book value of the property purchased was properly chargeable to construction cost rather than to operating expenses, and it was also impossible to ascertain whether other expenditures constituting a part of the balance of the tangible book value were prudently and wisely made. Therefore, it was held, any determination as to the book value of the company would be no more than a conjecture and consequently of very little use.

In the valuation an estimated deduction from book value was made for property purchased from previous companies which has been abandoned and was not in use or useful in the operations of the present company, and where there was no evidence to show any depreciation deductions on the abandoned property. The commission was of the opinion that no allowance upon the present fair value of the utility should be set aside annually to protect the company against extraordinary accidents of the future.

The commission was also of the opinion that in the performance of its duties in the regulation of public utilities it must act in a dual capacity and not only protect the public in the charges it shall be required to pay, as well as in the adequacy of the service, but at the same time protect the utilities and their stockholders from losses due to poor management. The commission will take the position in rate cases of condemning wasteful cost in operation and at the same time encouraging efficient management, and it believes that it would indeed be unwise to prohibit an operating company from paying annually into the treasury of a holding company a sum of money equaling 2 per cent of the gross sales to cover general supervision expense.

New Power Plant for New Bedford.—The New Bedford (Mass.) Gas & Electric Light Company is making arrangements for the erection of a new power plant to have an initial rating of 22,000 kw.

Boston Edison Company Has Thirtieth Birthday.—Thirty years ago, on Feb. 20, the Boston Edison Company, capitalized at $100,000, placed in operation its first station. Its first lighting customer was the Bijou Theater, and before the end of 1886 it had ninety customers and 4847 50-watt equivalents connected. On its thirtieth birthday the company had a capital of $22,518,200, about 84,000 customers, and approximately 5,000,000 50-watt equivalents.

Los Angeles Seeks Power Permit from Federal Government.—The city of Los Angeles has received the permission of the California Railroad Commission to file applications with the Forest Service of the United States Department of Agriculture for a preliminary power permit, including rights-of-way for storage and diversion reservoirs, conduits, dam sites and water-power plant sites on Big Pine Creek, Cottonwood Creek and the Owens River Gorge. This action was taken in the interest of certain desired power rights-of-way and of protecting the city's interests in certain water and power holdings in the Long Valley district, where the city is involved in litigation with private power interests.

Central-Station Supports Fellowship for Study of Boiler-Tube Troubles.—The Detroit Edison Company has given to the chemical engineering department of the University of Michigan the sum of $600 to support a fellowship during the present college year, the object of the endowment being an investigation of the causes that lead to the frequent failure of boiler tubes in service. A number of tubes, some of which have failed and others of which have rendered good service, will be subjected to careful chemical and microscopic examination to determine, first, whether the metal is of the proper chemical composition, and second, whether the material has been properly manipulated by the manufacturer. The work will be in the charge of Prof. Albert E. White.

Southern Idaho Millers Get Reduced Rates.—A uniform schedule of reduced rates for the millers of southern Idaho has been filed with the Public Utilities Commission. The schedule was agreed to by the Electric Investment Company, the Southern Idaho Power Company and the millers, and provides an inducement to operate the mills a greater length of time. The demand rate is $1 per month per horsepower, 3 cents per kilowatt-hour up to 30 kw.-hr., 2 cents per kilowatt-hour for the next 22.5 kw.hr., and 0.5 cent per kilowatt-hour for all over that amount, with a load-factor discount. The rate applies to alternating-current service for single installations of 50 hp. or over. The schedule is optional with consumers who are being served in accordance with the terms and conditions of contracts entered into before May 8, 1913.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Rates for Street Lighting in Seattle Increased.—The president of the Seattle City Council has, over the protest of the Mayor, fixed the rates for street lighting for 1916 at 4.5 cents per kilowatt-hour. The city, which is served from a municipal plant, formerly enjoyed a rate of 4 cents per kilowatt-hour for this service.

Institute Formed to Promote Government Business Efficiency.—"An institute for government research" was incorporated in Washington on March 13, the fundamental purpose of which, according to its incorporators, is to apply the test of efficient business methods to administrative and governmental activities and to co-operate with public officers in promoting efficiency. Frank J. Goodnow, president of Johns Hopkins University, will head the institute's board of trustees. Headquarters will be in Baltimore. The organization will be supported by voluntary contributions, and administrative experts will be employed. The first work will be in connection with the federal government.

Massachusetts Legislature Considering Bills on Municipal Ownership.—After a joint debate between representatives of various lighting companies throughout the State and Representative Morrill, father of the bills, the Massachusetts legislative committee on public lighting has taken under consideration two bills affecting municipal ownership. One provides for the repeal of the law which makes it obligatory on a municipality wishing to engage in the lighting business to purchase the existing company if there be one. The other seeks to repeal the law which requires that a city or town may establish municipal lighting plants on a majority vote, instead of a two-thirds vote, of the City Council for two successive years.

Twelve-Year-Old Conduit Suit Before Referee.—After twelve years of litigation, the action of the city of New York against the Consolidated Gas & Electric Subway Company has been submitted in finality to a board of referees for determination. On the outcome of the suit depends the control of the underground electrical conduits in Manhattan. The franchise was given under contract of the company to pay the city all above 10 per cent profits, but the books have never showed that much profit. The city charges fraud and sues for an accounting involving several millions of dollars and forfeiture of the franchise. Besides this suit against the Consolidated company, which involves conduits for the New York Edison Company's high-tension wires, there is another one pending against the Empire City Subway Company, involving the telephone company's low-tension wires.

Detroit Edison's New Monthly.—With an issue for March the Detroit Edison Company begins the publication of a monthly company magazine called *The Detroit Edison Synchroscope*. The new bulletin will be devoted to all interdepartmental activities and interests.

Workmen's Compensation for Kentucky.—The Kentucky Legislature has passed the workmen's compensation bill which has been before it since early in the session. It provides for insurance with the commercial companies or with mutual organizations and does not create a state fund, and it is virtually compulsory, since those employers who do not take advantage of its terms are deprived of the usual common-law defenses in cases of employees' claims.

Westinghouse Men Banquet at Pittsburgh.—Approximately 500 members and guests of the Westinghouse Club assembled at the sixth annual banquet of that organization at the Fort Pitt Hotel, Pittsburgh, Pa., on March 11. Truman P. Gaylord, vice-president of the Westinghouse Electric & Manufacturing Company, acted as toastmaster. Addresses were delivered by Wesley G. Carr, one of the company's attorneys, on "The Potency of Service"; William L. Saunders of the Naval Consulting Board on "Industrial Organization for Peace and War," and Rev. Samuel M. Lindsey of Pittsburgh on "Imagination and Life."

Duplication of Idaho Systems Being Removed.—The Electric Investment Company, with headquarters at Boise, is taking out a part of the electric distributing system of the Idaho Power & Light Company in the Twin Falls region. Eventually the entire distributing system will be removed, and only the Great Shoshone & Twin Falls Water Power Company's system will be used in this part of the country. At Buhl the Great Shoshone distributing system will be removed and the Idaho Power & Light system will remain. Arrangements will be made, however, whereby either town may be supplied from both stations in case of emergency. Power for Twin Falls will come from the Shoshone Falls plant, while that for Buhl will be taken from the plant at Malad.

Indianapolis Company to Go After Electric-Range Load.—The Merchants' Heat & Light Company of Indianapolis has made the first formal move in a campaign to encourage the use of electric ranges throughout the company's territory. This week a petition was filed with the Public Service Commission asking authority to place a new rate in effect in addition to other schedules of the company heretofore approved and passed on by the commission. This new rate will give the user of such electric appliances as ranges a final step in the rate which will bring ranges and other cooking apparatus to a 3-cent basis. Rate experts of the company believe this rate will be low enough to encroach on the Indianapolis artificial-gas rate—one of the lowest in the country—which is 55 cents per 1000 cu. ft.

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

Indiana Electric Light Association.—The annual meeting of the Indiana Electric Light Association will be held at Kokomo, Ind., on April 19.

Chicago Jovian League.—On Feb. 23 the Chicago Jovian League held a rejuvenation at the Sherman Hotel, at which ten new members were initiated.

Illuminating Engineering Society.—A new list of members is now being prepared for publication and will be available for distribution about May 1.

Electrical Supply Jobbers' Association.—The next meeting of the Electrical Supply Jobbers' Association will be held at Hot Springs, Va., June 7, 8 and 9.

New England Section, I. E. S.—Dr. C. P. Steinmetz will be the speaker at the next meeting of the New England Section of the Illuminating Engineering Society on April 13.

Pittsburgh Electrical Association.—Jackson D. Haag spoke on Feb. 29 before the Pittsburgh Electrical Association on "The Newspaper and Its Relation to the Electrical Industry."

Detroit-Ann Arbor Section, A. I. E. E.—The annual banquet of the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers was held on March 17 at the Fellowcraft Club.

Dallas Electric Club and Jovian League.—The Dallas (Tex.) Electric Club recently voted to amend its constitution so as to change the name of the body to the Dallas Electric Club and Jovian League.

Pittsburgh Section, I. E. S.—At the next meeting of the Pittsburgh Section of the Illuminating Engineering Society W. D.'A Ryan will speak on the "Lighting of the Panama-Pacific International Exposition." A symposium on interior lighting will be held at the meeting on April 21.

Export Buyers' League.—There is now being formed in New York City an association of men who purchase for export which will be known as the Export Buyers' League. Membership in the league includes membership in the Purchasing Agents' Association of New York. The next meeting of this latter society will be held at Reisenweber's on March 21.

New Haven Section, A. I. E. E.—There will be a joint meeting of the New Haven Section of the American Institute of Electrical Engineers with the local sections of the civil, mechanical and mining engineering societies at the Mason Laboratories, Sheffield Scientific School of Yale University, on April 15. Samuel Insull, president of the Commonwealth Edison Company, will deliver an illustrated address on "The Progress of Economic Power Generation and Distribution."

Minnesota Electrical Association.—The ninth annual convention of the Minnesota Electrical Association will be held at the Radisson Hotel, Minneapolis, on March 21 and 22. In order to make the sessions of greater interest and more "snappy" the 1916 convention has been shortened from three to two days. A further departure from the customary procedure will be a banquet at the close of the convention under the auspices of the association. There will be fewer papers this year, but they will be about equally divided between technical and commercial topics. The commercial end of the industry will be featured this year more than ever.

South Dakota Electric Light Association.—The initial steps toward the formation of the South Dakota Electric Light Association were taken at a meeting of central-station men at Sioux Falls on Feb. 22. Robert Ferris, manager of the Yorktown Light, Heat & Power Company, was elected temporary chairman, and A. H. Savage, president of the Flandreau Light & Power Company, was elected temporary secretary. Following the reading of a paper on "Corporation Accounting" by Mr. Ferris, a business meeting was held. A permanent organization will be effected at the next meeting, which is to be held in Watertown at a date to be announced later.

American Society of Mechanical Engineers.—The spring meeting of the American Society of Mechanical Engineers will be held from April 11 to 14 inclusive at New Orleans. The opening session will be devoted to "Industrial Preparedness," with a paper by Spencer Miller, member of the Naval Consulting Board. One of the speakers will be W. B. Thompson, commissioner of public utilities of the city of New Orleans. A session will consider engineering problems of the South, with papers on multiple evaporators, low-lift pumping plants in the Gulf Coast country, and mechanical equipment used in the port of New Orleans. At other sessions papers will be presented on measurement of flow of fluids, dynamic balance of machine parts, center-crank shafts of gas engines, transmission of heat, fuels, etc.

New York Jovian League.—The recently reorganized Jovian League of New York held its first formal meeting under the revised constitution at the Hotel Martinique on March 15. The report of the nominating committee was accepted, the following being elected: President, Arthur Williams, general commercial manager New York Edison Company; secretary, James R. Strong, president Tucker Electrical Construction Company; treasurer, A. S. DeVeau, president DeVeau Telephone Company; board of governors, E. W. Rockefellow, general supply sales manager Western Electric Company; James R. Pollock, New York manager New York Telephone Company; T. Beran, manager New York office of the General Electric Company, and W. S. Rugg, district manager Westinghouse Electric & Manufacturing Company. Hereafter the local chapter will meet weekly instead of semi-monthly as formerly.

New York Sections, I. E. S. and A. S. M. E.—The New York Section of the Illuminating Engineering Society held on March 14 a joint meeting with the New York Section of the American Society of Mechanical Engineers for the purpose of discussing the proposed code of lighting for factories, mills and other workplaces prepared by committees of the Illuminating Engineering Society. C. E. Clewell, assistant professor of electrical engineering of the University of Pennsylvania, presented a paper on "Modern Aspects of Factory Lighting and the New Code," and L. P. Alford, editor of the *American Machinist*, read a prepared discussion of the code. The meeting was arranged to acquaint the mechanical engineers with the contents of the code, to solicit their co-operation and to get their viewpoint, which it was brought out would be very beneficial when any further revision was made to the code. Professor Clewell's paper was prepared with that end in view. Mr. Alford assured the illuminating engineers of the support of the mechanical engineers. He spoke highly in favor of the work that had been done and very carefully discussed a number of the articles in the code from the standpoint of the mechanical engineer. His discussion was largely of a constructive nature.

The Southwestern Electrical & Gas Association.—The 1916 annual convention of the Southwestern Electrical & Gas Association will be held at Galveston, Tex., May 17, 18, 19 and 20, at the Hotel Galvez. The various sessions will be as follows: Interurban and street-railway sessions morning and afternoon, May 17, with gas members' sessions paralleling in another meeting-room; lighting and power sessions, morning and afternoon, May 18, with claim agents' sessions paralleling in another room, and general sessions, at which papers, addresses and discussions on topics common to all public utilities will be given, morning and afternoon, May 19. As an innovation each session will be in the hands of a committee selected from those members directly interested in the particular interest, kind or branch of utility business to which such sessions are to be devoted. The province of such committees will be to take entire charge of their sessions, select the topics to be made the subject of the papers, addresses, question box and discussions, and appoint the persons who will make the addresses, write the papers or open the discussions. A special committee has been appointed to present to the convention a full and formal report on the present status and work of the association and to make suggestions for a broadening of its scope and activities, and another special committee has been appointed on "publicity and public relations," with instructions to obtain the presence of and addresses from authorities on these subjects.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

Glassware Manufacturers to Keep Factories Running During Summer Months

At a conference held on Tuesday of this week between representatives of glassware manufacturers and organized labor at Pittsburgh, Pa., it was definitely decided to run the plants this year during the summer months. This is contrary to all precedent. It has always been the practice, it was stated to a representative of the ELECTRICAL WORLD, to close down the factories for a month or two during the hottest period of the year to make necessary repairs to equipment and to take inventory. It is not possible to make thorough repairs with the plant in operation. The furnaces, it was pointed out, once lighted burned until cleaning time, ten months later. Because efficiency of operation demands that the furnaces run as long as possible at a stretch, all repairs that can wait are generally held up until the summer months, when there is a general overhauling of the plant.

This year, however, no such shut-down will occur. Orders, it is said, are coming in too rapidly and deliveries are becoming as a result too long to make it possible to put out the fires. Furthermore, the loss of time due to the customary low supply of natural gas in cold weather was extraordinarily disadvantageous this year. The volume of buying is so large that any time that was lost by insufficient fuel supply was more keenly felt this year than in former years and has acted to a certain degree as a check against summer closing. The entire facts of the conditions underlying the present market in electrical glassware will be found in this section of last week's issue, March 11.

Just how far this plan will be carried out is unknown. It is felt by some that so great will be the requirement for repairs that to adhere strictly to this agreement will be impossible. A possible, and indeed a probable, solution of this difficulty will be the partial closing down of factories at different times. In other words, the factories will not shut down as a whole but department by department. As soon as one department has received its overhauling it will open again and another department will be closed, and so on.

Carbon Products Selling Well

Business in carbon products for electrical purposes is at the present time in a strong position. The demand, while not phenomenal, is healthy and shows good prospects. To a certain extent the volume of domestic buying has been heightened by the stoppage of the imports of foreign carbon. Before the war broke out Austrian and German carbon products enjoyed a wide sale in this country, but, since it is now impossible to obtain materials from either country, the domestic buyers are forced to turn to the domestic products.

In the export field the American manufacturers are finding for the first time, it is stated, a market for American-made products. Orders are coming from every country in Europe whose ports are open to commerce, from South America, and from the British colonies in the Southern Hemisphere.

The foreign demand is especially strong for lighting carbons. In the Scandinavian countries, where there are large water-power developments and large electrochemical industries, there is a strong market for electric-furnace carbon electrodes.

The domestic buying of carbon products, as far as could be learned, is good in all classes of materials. Carbon brushes are selling particularly well at the present time. The greatest improvement is seen in the volume of buying of carbon electrodes for electric furnace work in the electrochemical industries. The war conditions have heightened the demand for electrochemical products and have greatly increased, of course, the buying of necessary supplies. Particularly is this seen in the electric-steel industry in this country. Up to quite recently Germany led the world in the number of electric furnaces engaged in the production of steel, but the latest reports place the United States considerably ahead of Germany. Electric steel is finding a larger and wider sale every day, and just at present the conditions of the steel market necessitate the maximum production at every source.

The domestic market for lighting carbons is said to be fair. The high-grade carbons for flaming arcs formerly obtained from Germany and Austria cannot now be had at any price in this country, because of the war.

Deliveries of domestic carbons are still good, and it is felt that there is every prospect of their remaining so. There is no difficulty in getting the raw materials, and the only serious drawback is the congestion of the nation's freight service. This by no means causes delays in every case, but frequently shipments have been held up for some time.

There has been no change, as far as could be found out, in the prices for carbon products. Raw materials have not advanced, and the manufacturers have not been forced to increase their prices. This, of course, is true only for the carbon products alone. When the carbon is a part of the finished product the condition does not necessarily hold. Carbon brushes, for instance, with copper-plated connecting surfaces, it is stated, demand a better price to-day than before copper began to advance. Moreover, those to whom the ELECTRICAL WORLD talked could not foresee any advance in price, at least in the near future.

There has been no change, as far as it could be learned, in either credits or collections.

The Graves Engineering Company has moved from 35 Pine Street to 25 Pine Street, New York.

The Reflectolyte Company.—The Frank Adam Electric Company, St. Louis, Mo., has recently changed its name to the Reflectolyte Company.

W. B. Pierce has opened an office at 333 Old South Building, Boston, Mass., from which he will direct the Eastern sales work of the Hughes Electric Heating Company of Chicago.

Curtis & Carhart, Inc., 150 Chambers Street, New York, manufacturers' representatives, have appointed L. F. Tissot, Jr., formerly with the Century Electric Company, as a member of their staff.

The Bright Star Battery Company, 430 West Fourteenth Street, New York, has established a branch office in San Francisco, Cal., which will be in charge of Nicholas Abrams. The company will carry a stock of its products at this office.

T. C. Hawkins, who was special syndicate representative for the Westinghouse Lamp Company at Philadelphia, Pa., has been appointed direct traveling representative for the Holophane Glass Company, Inc., 340 Madison Avenue, New York City.

Large Demand for "Celestialite."—The Gleason Tiebout Glass Company reports a large demand for its new fixture glassware, "Celestialite." Some very satisfactory orders have been received from London and from South America. This glass, the company claims, is a true daylight glass. Several large orders have recently been received for the relighting of prominent department stores in New York City.

Charles E. Kacin, who for twelve years has been connected with the sales department of the Central Electric Company of Chicago, has accepted a position as Chicago representative for the Adams-Bagnall Electric Company of Cleveland.

Western Electric Sales for 1915.—The Western Electric Company's business for 1915 was better, on the whole, than was expected. The sales amounted to $63,852,000, of which $38,394,000 represents sales to the companies of the Bell Telephone System.

The Standard Electric Company of Minneapolis, Minn., has moved from 13 North Sixth Street to 239 Plymouth Building, where accommodations have been obtained to meet the company's rapidly growing business. Fred G. Dustin and C. W. Arrick are proprietors of this concern.

The Hayward Company, 50 Church Street, New York, manufacturer of power-plant apparatus, has announced that after March 1 all prices published or otherwise quoted by the company will be withdrawn, and that after that date and until further notice prices will be issued only on application.

The Alamo Farm Light Plant Company of Omaha, Neb., has recently opened a branch office and display room at Eighth Street and Iowa Street, Dubuque, Iowa. The sales territory embracing eastern Iowa, western Illinois and Wisconsin will be under the management of this branch office. It is also the intention of the company to open eventually an assembly plant in Dubuque.

Large-Turbine Order.—The I. P. Morris Company has just secured the contract for one 19,500-hp. vertical-shaft, single-runner turbine to operate under a head of 68 ft. at a speed of 100 r.p.m. for the Lock No. 12 development of the Alabama Power Company on the Coosa River. The unit is to have a rating of 2000 hp. greater than the existing I. P. Morris units in the same station, the head and speed for each of the five machines being the same.

The Main Electric Manufacturing Company, 500 Aiken Avenue, Pittsburgh, Pa., has increased its capital stock from $100,000 to $300,000, the increase being necessary on account of the larger business being received. According to M. E. Main, president of the company, the export business of the company is very satisfactory, and the company has also been noting a general increase of business in this country. It recently doubled the floor space of its plant.

New Orleans to Have Electrical Show.—It has been announced by W. E. Clement, chairman of arrangements, that the recently organized Jovian League of New Orleans will feature an electric show in that city early in April. The final arrangements, it is expected, will be announced shortly. Aside from spectacular features the league will put on what will be almost exclusively a "household show," bearing particularly on efficiency and modern methods in the home. In connection with the show there will be a pure food exhibit.

Milwaukee Concern to Handle Roberson Products.—The Electrical Engineering & Equipment Company, Wells Building, Milwaukee, Wis., will act as exclusive sales agent for the products of the Roberson Electric Appliance Company, manufacturer of the Roberson emergency connector and meter attachment. The Electrical Engineering & Equipment Company, of which Philip Grossman is president and general manager, wishes to get in touch with representative sales organizations throughout the country to assist in the sale of these products.

General Electric Company Increases Price of Its Products.—Owing to the steady advance in raw materials, the General Electric Company, Schenectady, N. Y., has made a general advance of 10 per cent in the price of its electrical goods. This general increase in prices has been expected for some time and follows the advance in prices made in motors and one or two other lines of apparatus two months ago. It is understood that the Westinghouse company has also made advances in the prices of its products which are similar in amounts to those made by the General Electric Company.

Display Stand for Automobile Lamps.—The Wood Manufacturing Company, Fairfield, Conn., has just brought out a 1916-model display stand for its "Newtype" automobile spot lamps and Ford lamps, which it is supplying to jobbers and dealers throughout the country without charge except for the lamps. Various types of spot lamps made by the above-named manufacturer are shown on this stand, and the display is so arranged that the backs of some of the lamps and the fronts of others can be seen. It is thereby possible for persons looking at the stand to see the rear-view mirror which is in the back of all the lamps.

Large Number of Employees on Westinghouse Payroll.—It is reported that the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has a record number of employees on its payrolls at the present time, and that on account of the great rush of business more than 20,000 persons are working for the company. The company is continuing to receive large orders, among the most prominent of which is one recently received from the National Tube Company for the equipment of its new 40-in. reversing mill, as already noted in these columns. The company has also received substantial orders from other steel companies.

Tinted Glassware Advances in Price.—The ELECTRICAL WORLD has received information to the effect that certain classes of colored or tinted glassware for electrical purposes have advanced considerably in price. In some grades the advance has been as much as 50 per cent. Back of this advance, of course, is the condition of the market for raw materials. Chemicals and dyes, besides being much higher in price, are very difficult to obtain, especially the latter. These facts, in addition to the general conditions underlying the glassware market as a whole, as reported in these columns for March 11, have been instrumental in the present advances.

Robbins & Myers Club.—The Robbins & Myers Company, Springfield, Ohio, is maintaining a club for its employees, all of whom are eligible for membership. No dues are charged since all expenses are taken care of by the company. Spacious club rooms are kept up by the company, the entire top floor of the Bushnell Building Annex being utilized for the purpose. One of these rooms is in the form of an auditorium in which meetings and entertainments are held. A prominent speaker is engaged once a month to address the club members. A band which is equipped and provided with a director by the company also gives occasional concerts. A banquet is a feature of the monthly meetings. The reading-room of the club is provided with all the general and technical magazines and also an electrically operated victrola. A large billiard room forms part of the club's equipment.

Traveling Screens to Be Marketed by Chain Belt Company.—For several years the Chain Belt Company of Milwaukee, Wis., has been developing self-cleaning traveling water-intake screens. The screens that have been built during that period were largely made at the request of consulting engineers and central-station engineering departments. Now, however, the mechanical design has been carefully considered; the screens that are in use have given satisfaction, and the company feels that the experimental stage is past. The company has therefore announced that it is ready to push the sale of these screens aggressively. The Northwest station of the Commonwealth Edison Company, Chicago; the Delray and the Conners Creek plants of the Detroit (Mich.) Edison Company and the Commerce Street plant of the Milwaukee (Wis.) Electric Railway & Light Company are among the present users of these traveling screens.

Ten New Electric Trucks for Boston.—Orders for ten new electric trucks to be added to the fleets at Boston, Mass., have recently been booked by the General Vehicle Company, Long Island City, N. Y. Six 3.5-ton trucks will be utilized by a contractor in street watering, flushing and oiling, the installation to be completed about April 1. Energy will be supplied by the Edison Electric Illuminating Company, and the trucks will be run upon the battery-service basis. A 2-ton truck has also been purchased by G. F. Richardson, a wholesale grocer of Newton, for Boston-Newton service, and another machine of the same size has been ordered by H. E. Wright, a tin-can manufacturer of Charlestown. Other orders include a 1000-lb. light delivery wagon for the coffee house of Chase & Sanborn, Boston, and a 3.5-ton truck for the H. J. Hering Company, Boston, pickle manufacturer. The Burton-Furber Company, coal dealer, also has lately ordered two 5-ton trucks.

Cooper Hewitt Lamps for Motion-Picture Studios.—During the last two months, the Cooper Hewitt Electric Company, Hoboken, N. J., announces, ten large motion-picture studios have adopted the Cooper Hewitt lamps for lighting their indoor stages for motion pictures. This type of illumination is now used in fifty-one studios, with nearly 8000 lamps in service. The majority of the lamps are for use in dark studios. It is interesting to note in this connection that Cooper Hewitt lamps have been adopted by a number of motion-picture companies for use in their studios in California, where on account of the excellent daylight conditions supposedly available the concerns have installed large motion-picture plants. The manufacturer also points out that the Cooper Hewitt lamps are being increasingly employed in newspaper composing rooms, where great care must be taken to relieve as much as possible the eye strain incident to fine detail work. Low intrinsic brilliancy and absence of dark shadows, with a minimum of glare, are obtained with these lamps, and therefore they are particularly well adapted for use in composing rooms. They are also meeting with favor, it is asserted, in industrial plants.

NEW YORK METAL MARKET PRICES

	March 7 Selling Prices Bid	Asked	March 14 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	100 10 0		105 0 0	
Prime Lake	27.25	to 27.50†	27.50	to 27.75†
Electrolytic	27.25	to 27.50†	27.50	to 27.75†
Casting	25.87½	to 26.12½†	25.50	to 26.00†
Copper wire base	28.75	to 29.25†	29.00	to 29.50†
Lead	6.60		7.00	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	25.00†		25.00†	
Spelter	18.67½	to 18.92½†	16.80	to 17.05†
Tin, Straits	48.50		55.00†	
Aluminum, 98 to 99 per cent.	59.00	to 61.00	57.00	to 59.00†

OLD METALS

Heavy copper and wire	21.50 to 22.00†	21.00 to 21.50£
Brass, heavy	13.50 to 14.00†	13.50 to 14.00†
Brass, light	12.00 to 12.50†	11.50 to 12.00†
Lead, heavy	5.40 to 5.50†	5.75 to 5.85†
Zinc, new, scrap	15.00 to 15.50†	14.00 to 15.00†

COPPER EXPORTS

Total tons to March 14 6,833

†Nominal.

Corporate and Financial

Alturas (Cal.) Electric Light & Power Company.—The California Railroad Commission has authorized the company to issue $90,000 of first mortgage thirty-year 6 per cent bonds and to execute a deed of trust to its property to secure a bonded indebtedness of $100,000.

Choctaw Railway & Lighting Company, McAlester, Okla.—Judge Campbell of the federal court has granted the petition of the receivers of the company to issue receivers' certificates to the amount of $130,000 for the improvement and enlargement of the properties of the company. Business which would bring an additional gross income of $160,000 a year, it is stated, can be secured by the company by making the improvements contemplated in the petition for the authorization of the certificates. The receivers, E. E. Fisher and Allen Wright, point out that the maintenance of the properties demands the expenditure of certain sums of money for improvements and additions. It is shown that the operators of a number of coal mines in Pittsburg County would prefer to buy their power from the Choctaw company rather than to install their own plants, as they will be forced to do if the company does not extend its lines to these properties. Among other plans, the purchase of the Degnan & McConnell Electric Light Company at Wilburton is contemplated.

Cumberland County Power & Light Company, Portland, Me.—The Maine Public Utilities Commission has authorized the company to issue $250,000 of its first and refunding mortgage 5 per cent bonds, due Sept. 1, 1942, at not less than 93. The proceeds will be used to reimburse the company's treasury to the amount of $99,829.72, expended for additions, extensions and improvements to its properties made during 1915, and to the amount of $125,000, paid to the Pepperell Manufacturing Company for the water privilege known as the Hiram Falls privilege. The remainder will be used in partially developing this water privilege.

Derry (N. H.) Electric Company.—The New Hampshire Public Service Commission has authorized the purchase by the Derry Electric Company of the New Hampshire Water & Electric Power Company and the Jaffrey & Troy Electric Light Company. For the former the commission authorizes the payment of $60,000 and for the latter $15,000, following an exhaustive investigation of the value of the properties, their depreciation and accounting methods. The Derry company is authorized to issue 750 shares of 6 per cent cumulative preferred stock at $100 par value to meet the costs above outlined. The properties will be placed under a single experienced management, with improvements in service and reduced rates.

Kansas City (Mo.) Railway & Light Company.—The reorganization managers of the street-railway and electric-light systems at Kansas City, Mo., have notified the depositors of notes and bonds under the plan prepared by Judge Hook that the interest money they are entitled to is payable March 15. The interest to be paid is as follows: Metropolitan consols, 7.25 per cent; railway 5's, 7.75 per cent; railway 6's, 5.33 per cent; Central Electrics, 6.5 per cent; Corrigans, 5.25 per cent; East Side Electrics, 5.75 per cent; notes to banks, 2.75 per cent; Westports, 5 per cent; Elevated 6's, 5.75 per cent, and Elevated 4's, 4.16 per cent.

Madison (Ind.) Light & Railway Company.—The Public Service Commission of Indiana has authorized the company to issue $13,000 par value of its stock for new construction to its power plant between Nov. 1, 1913, and Nov. 1, 1915.

Middle West Utilities Company, Chicago, Ill.—A block of ten-year 6 per cent collateral gold bonds due Jan. 1, 1925, is being offered for investment. The proceeds will be used to retire the remaining $2,652,300 three-year 6 per cent collateral gold notes due Jan. 1, 1916, of which issue $847,700 have already been retired, and to reimburse the company's treasury for funds used in the development of its subsidiary companies.

Oxford (Me.) Electric Company.—The Maine Public Utilities Commission has granted the request of the Oxford Electric Company for permission to buy the property of the Mechanic Falls Electric Light Company and issue securities. The consideration is $30,000 in 6 per cent non-cumulative preferred stock of the Oxford Electric Company delivered to the holders of the present capital stock of the Mechanic Falls Electric Company, share for share, provided, however, that the present stockholders of the Mechanic Falls Electric Company may first declare and pay a cash dividend of 12 per cent on its capital stock now outstanding from cash now in the treasury.

San Diego (Cal.) Consolidated Gas & Electric Company.—Following the new policy of the Byllesby utility companies of encouraging investment by citizens of the community served, the San Diego Consolidated Gas & Electric Company is offering its new issue of $500,000 7 per cent preferred stock direct to the people of that city. Subscriptions are being received subject to the approval of the issue by the Railroad Commission of California, and proceeds will be used to retire $356,000 of 6 per cent debenture bonds due in 1922, to pay floating indebtedness and to provide capital for extensions. The company's present capitalization consists of $4,266,000 first mortgage 5 per cent bonds, due in 1939; $356,000 6 per cent debenture bonds, due in 1922, and $2,955,000 common stock. The stock is being offered directly to the people of San Diego in a series of newspaper advertisements, in which the fact is brought out that the company has no difficulty in financing its requirements in the general investment markets of the country but prefers to build up and increase home proprietorship. Some of the reasons given are as follows: (1) To make the public and the utility company actual financial partners as well as partners in community advancement; (2) to provide investment for surplus capital and savings of citizens in a stable enterprise which they have under their personal observation; (3) to accomplish a step toward the popularization of the company, and (4) to bring about a distribution of profits among customers. Subscriptions are being taken for the

stock at par, either on a cash or a partial-payment basis. The terms of the partial-payment plan are 20 per cent cash and the balance in ten equal monthly installments, the partial-payment feature being offered primarily for the purpose of enabling wage-earners and small-salaried men or women to acquire stock in the company.

Seattle Municipal Lighting Plant.—The municipal lighting department of the city of Seattle had gross earnings during 1915 amounting to $1,067,180.02. The net earnings of the department for the year were $199,088.80. Commercial lighting brought a revenue of $577,521.95, while commercial power added $121,469.75, street lighting $199,994.95, city buildings and grounds $26,303.10, city power $34,049.92, other public buildings $3,949.35, miscellaneous revenues $441, and miscellaneous rentals $3,450. The expenses of the department include $56,160.16 for water-power generation, $112,466.26 for steam-power generation, $2,079.18 for energy purchased, $40,951.99 for transmission and transformation, $323.26 for storage, $160,656.28 for distribution, $85,690.55 for commercial expenses, $101,052 for general expenses, $178,627.72 for depreciation, $112,016.61 for interest, bad debts and other items, $9,281.25 for appropriations, and $8,785.96 for profit and loss adjustments, leaving a net balance for the year of $199,088.41. During 1915 $400,000 of steam-plant bonds were sold, bringing the outstanding bonded indebtedness of the light system to $3,923,000. During the year $71,000 of bonds were retired. The light and power system has a valuation given by the State accountants of $6,786,257.80, including the new masonry dam, to which is given an investment value to date of $1,508,821.26. The above report was filed by the State Bureau of Accountancy at Olympia, Wash., and is the first that has been made on the city lighting department by the State accountants.

Swarz Electric Company, Indianapolis, Ind.—The company, which manufactures house-lighting plants, has issued $150,000 of 7 per cent preferred stock. There is also $150,000 of common stock outstanding. The company intends to purchase a large amount of new equipment.

Texas Power & Light Company, Dallas, Tex.—At a recent meeting of the board of directors the sale of $200,000 bonds was authorized. The proceeds will be used to pay for certain improvements of the company's power-transmission system. The company plans to make important extensions of its electrical transmission systems during the present year. During the past few months it purchased several electric light and power plants in different parts of the State, and these will be connected up with the general power-transmission system and the number of plants added to from time to time during the year.

New Utility and Industrial Companies

The Paden Light & Power Company of Paden, Okla., has been chartered with a capital stock of $10,000 by A. G. Rogers, W. E. Davis and W. G. Botts, Paden.

The Kentucky Light & Power Company of Fulton, Ky., has been incorporated with a capital stock of $250,000 by O. LeNeve Foster, C. M. Goheen and E. S. Hodgman.

The Neosho Electric Company of Neosho, Wis., has been incorporated by E. J. Labuwi, M. Labuwi and others. The company is capitalized at $6,000 and intends to operate an electric-light plant in Neosho.

The Southern Electric Company of Birmingham, Ala., has been incorporated with a capital stock of $5,000 to engage in electrical and steam construction work. The incorporators are J. L. Hall, H. M. Hall and N. T. Thomas.

The General Lead Battery & Electric Company of New York, N. Y., has been incorporated by H. H. Hanson, E. S. Hyde and H. M. Keith, 17 Battery Place, New York. The company is capitalized at $20,000 and purposes to do a general electrical, mechanical and general contracting business.

The Roundtree Company of Klaber, Wash., has been incorporated with a capital stock of $25,000 and intends to operate an electric light and power plant, telephone system and tramways; also to engage in a merchandise and real-estate business. P. H. Roundtree is promoter of the company.

Trade Publications

Plugs and Receptacles.—Harvey Hubbell, Inc., Bridgeport, Conn., has prepared an illustrated folder printed in colors descriptive of three-wire plugs and receptacles.

Electric-Light Bath and Baker.—Walter S. Edmands, 134 Congress Street, Boston, Mass., has prepared an illustrated leaflet descriptive of a portable electric-light bath and baker.

Electrical Supplies.—A supplement and discount sheet applying to its Catalog No. 200 is being sent out by the Wesco Supply Company, Seventh Street and Clark Avenue, St. Louis, Mo.

Fans.—"The Death of All Fan Contracts" is the title of a circular being sent out by the Kandem Electric Company, 49 East Twenty-first Street, New York, which contains information on its electric fans.

Vapor-Proof Fixtures.—The Wheeler Reflector Company, 156 Pearl Street, Boston, Mass., has prepared Bulletin R, on its "Para-steel" vapor-proof fixtures for industrial lighting with multiple tungsten lamps.

Lightning Arresters.—The Electric Service Supplies Company, Seventeenth and Cambria Streets, Philadelphia, Pa., is sending out its new 1916 catalog on Garton-Daniels lightning arresters and other types of protective apparatus.

Insulating Cable Joints.—"Conducell, A Method of Insulating Cable-Joints in Underground Transmission Systems," is the title of an illustrated bulletin recently published by the Mica Insulator Company, 68 Church Street, New York.

Electric Hoists.—The Brown Hoisting Machinery Company, Cleveland, Ohio, has recently published Catalog D, which is extensively illustrated and describes various types of tramrail systems, trolleys and electrically operated hoists.

Self-Contained Generating Plants.—Bulletin No. 20, published by the Universal Motor Company, Oshkosh, Wis., is illustrated and contains information on various types of small self-contained gasoline-engine-driven generating plants.

Electric Radiators.—The Lee Electric Radiator Company, 14 East Jackson Boulevard, Chicago, Ill., has issued an illustrated folder descriptive of the Apfel system of electric heating and also a folder which describes and illustrates a small electric radiator for use in electric pleasure cars.

Projection Apparatus.—"Balopticons and Accessories" is the subject of a very complete and extensively illustrated catalog on apparatus for various forms of optical projection, including methods for scientific demonstration, issued by the Bausch & Lomb Optical Company, Rochester, N. Y.

Electrical Supplies.—The Belknap Hardware & Manufacturing Company, Louisville, Ky., has just issued Catalog No. 55, which lists that company's stocks of electrical merchandise, including automobile accessories, tungsten lamps, conduit and conduit fittings, flashlamps, storage batteries, transformers, switches, wiring accessories, domestic electrical appliances, etc.

Converters, Motors and Switchboards.—Commutating-pole rotary converters are described and illustrated in Leaflet No. 3823-A, just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., which states that 1,750,000 kw. is the total rating of Westinghouse rotary converters now in operation. "Modifications of the Standard Type CS Motor" is the title of Catalog Section IP45, also prepared by the Westinghouse company. The company has also just brought out a twenty-page folder entitled "Some Installations of Westinghouse Switchboards."

Pole-Line Hardware.—Hubbard & Company, Pittsburgh, Pa., have recently brought out a very complete illustrated 216-page, 8.5-in. by 10-in. catalog which contains a complete listing of its pole-line hardware and Peirce construction specialties. The catalog is really an encyclopedia of line material, and each article listed is illustrated. Numerous illustrations and detail drawings are also utilized to show the way the material is used in actual practice. Altogether, 616 illustrations are employed. The catalog is divided into sixteen sections in each of which material is grouped according to the purpose for which it is employed, as, for instance, guying materials, cross-arms and fittings, etc.

New England

RUMFORD, ME.—Work will soon begin on the construction of a new concrete dam for the Rumford Falls Pwr. Co. several hundred feet nearer the falls than the present one. A new power house will be erected having a capacity four times that of the present one.

ST. JOHNSBURY, VT.—The Essex Storage El. Co., recently incorporated with a capital stock of $200,000, proposes to build a large storage reservoir on the Victory Bogs and develop power along the Moose River. The company plans to construct a dam at Victory, at a cost of about $135,000, and to furnish electricity in St. Johnsbury and nearby towns. The incorporators are Theodore W. Chase, Passumpsic; Charles C. Braley, St. Johnsbury, and others.

CHICOPEE, MASS.—Eight miles of three-phase, 2200-volt transmission line are being erected in connection with the municipal electric-lighting system. R. P. Benedict is manager.

EAST BRAINTREE, MASS.—The electric-light department is contemplating the installation of an additional 500-kw. turbogenerator in the municipal electric-light plant during 1916, and possibly a 500-hp. water-tube boiler. F. B. Lawrence is manager.

EASTHAMPTON, MASS.—The Easthampton Gas Co. is contemplating the erection of two new three-phase transmission lines from its plant at Mount Tom to Easthampton, a distance of 2½ miles. John N. Lyman is superintendent.

GREENFIELD, MASS.—The Greenfield El. Lt. & Pwr. Co. is installing two 535-hp. boilers with automatic stokers for 200 lb. pressure and 125 deg. superheat, and it will also make several small line extensions. Contracts have been placed for all material. H. S. Riddell is assistant manager.

NEW BEDFORD, MASS.—Plans are being prepared, it is reported, by the New Bedford Gas & Edison Light Company for the erection of a power plant to have an ultimate output of 80,000 kw. The initial installation will provide for an output of 22,000 kw. The company has recently secured contracts to supply energy to operate the new Manomet and Sharp mills when completed, which will require approximately 8000 kw.

PALMER, MASS.—The Central El. Co., Palmer, is contemplating extending its transmission lines into the town of Hampden. The street-lighting service will consist of 50 lamps. H. M. Parsons is manager.

READING, MASS.—The electric-light commission is contemplating the installation of an additional boiler in the municipal electric-light plant. John A. Stevens, Lowell, is consulting engineer. A. G. Sias is manager.

SOUTH HADLEY, MASS.—An appropriation of $2,000 has been made for extension of electric-lighting system to Alvord Street, South Hadley. Not yet decided when work will be started. Wilfred W. Scott is manager.

WORCESTER, MASS.—Plans are being prepared by the Worcester El. Lt. Co. for the construction of an addition to its power house and installation of additional turbogenerator and other machinery at its power plant on Webster Street, to cost about $250,000.

SOUTH NORWALK, CONN.—The citizens of South Norwalk have voted to appropriate $18,000, or as much as may be necessary, for the purpose of installing an ornamental street-lighting system in the business section and West Avenue to the armory. A. E. Winchester is manager of the municipal plant.

Middle Atlantic

BUFFALO, N. Y.—Application has been filed by the Buffalo General Electric Co. with the Public Service Commission for permission to issue $3,625,000, the proceeds to be used for construction of a new steam generating plant. The new station will be built in Tonawanda, where 14 acres have been acquired for a site, on which construction work has started. It is expected to have part of the new station in operation in the fall of 1916.

COHOES, N. Y.—Improvements are contemplated to the water-works system, including the installation of electrically driven pumps and metering of supply pumps and improvements at water-works station.

ELLENBURG, N. Y.—Valuable water rights on the Big Chazy River, 5 miles east of Ellenburg Depot, have been purchased by the Ellenburg Lt. & Pwr. Co., recently organized with a capital stock of $35,000, for the purpose of developing a hydroelectric plant. It is estimated that about 1100 hp. can be developed, which will be transmitted to Ellenburg Depot, Ellenburg Center and Ellenburg Corners. The company will take over the plant in Ellenburg Depot and extend the transmission lines about 8 miles further. Norman P. White, Ellenburg, is president of the company.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Plans have been filed for the power plant of the New York Steam Company to be erected at the corner of Water Street and Burling Slip. The building will be 116 ft. by 107 ft., five stories high. The cost is estimated at $370,000. Starrett & Van Vleck are architects.

NIAGARA FALLS, N. Y.—The plant of the Niagara Electrochemical Company was practically destroyed by fire on March 7, causing a loss of about $200,000.

TONAWANDA, N. Y.—The Aluminum Co. of America, Pittsburgh, Pa., has acquired an option on 40 acres of land on the Niagara River in the town of Tonawanda, and, if the land is acquired, will erect a plant, to cost upward of $1,000,000.

UTICA, N. Y.—The New York Central Railroad Company, it is reported, is contemplating the construction of a large electric plant in Utica to furnish electricity to light the railroad station and other purposes.

ALLENTOWN, PA.—The contract for the electrical work on the new Mosser School Building in Allentown has been awarded to the Macan, Jr., Company of this city for $8,785.

ALLENTOWN, PA.—Extensive improvements will be made to the system of the Lehigh Valley Transit Co. (involving an expenditure of $375,000), consisting of the purchase of new cars and the extension of the automatic signal service to all parts of the 150 miles of trackage not heretofore equipped with automatic devices. A new 10,000-kw. turbine has been ordered for the Front Street power station. Orders have also been placed for 60-cycle rotary converters for substations at Catasauqua, Stigersville and Slatington.

ALTOONA, PA.—The Penn Central Light & Power Company has closed a contract to supply energy (4100 hp.) to the Standard Steel Works at Burnham.

GRATZ, PA.—A franchise has been granted to the Johnson Construction Co., Harrisburg, for construction of an electric-light plant and water-works system in Gratz.

KANE, PA.—The Kane El. Lt. & Pwr. Co. is now installing a new engine and generator, etc., in its power plant and is erecting extensions to its transmission lines and also to the local distribution lines. The cost of the work is estimated at $35,000.

PHILADELPHIA, PA.—Plans and estimates have been authorized by Chief MacLaughlin of the Electrical Bureau for changing the electric-lighting system on Germantown Avenue from Butler Street to Wayne Junction.

PHILADELPHIA, PA.—The United Electrical Construction Company of Philadelphia has been awarded the contract for the electrical work, including engines and generators, for the new building, to be erected at Nineteenth and Walnut Streets, Philadelphia. The cost is estimated at $50,000.

QUAKERTOWN, PA.—The contract for the electrical installation in the new building being erected in Quakertown for the Victor Box Manufacturing Company has been awarded to the United Electrical Construction Company of Philadelphia at $10,000. About 500 hp. will be supplied from the transmission lines of the Lehigh Valley Light & Power Company. Kern Dodge of Philadelphia is engineer in charge.

CAPE MAY CITY, N. J.—The property of the Cape May Light & Power Company has been taken over by the National Gas, Electric Light & Power Company, Detroit, Mich., which controls the Cape May Illuminating Company. Extensive improvements are now under way, which, it is expected, will double the output of the plant. E. G. Jones has been retained as superintendent of the consolidated properties.

DOVER, N. J.—Plans are being prepared by the New Jersey Power & Light Company, which was recently organized to take over the properties operated by the Eastern Pennsylvania Power Company and affiliated corporations, for the construction of a large central generating station near Dover, with an initial installation of 3500 kw. The new plant will take the place of the present stations at Dover, Rockaway and Bernardsville, which will be held as reserve stations.

FREEHOLD, N. J.—The Monmouth Lt. Co. is contemplating extensions to its system. Application has been made by the company to the Council for a long-term franchise.

NEWARK, N. J.—Specifications for redecorating the city hall, together with the installation of a new lighting system, have been approved by the public building committee of the Common Council. Bids, it is understood, will be opened March 23. Hooper & Company are architects.

SUMMIT, N. J.—The Commonwealth Wtr. & Lt. Co., it is reported, contemplates increasing the output of its plant in Summit. New equipment, including new boilers and turbine unit, will be installed. Electrically driven pumps will also be erected in the pumping station.

SPENCER, W. VA.—The plant and holdings of the Robey Electric Company of Spencer have been purchased by R. G. Wieland of Audubon, Iowa. The new owner, it is understood, contemplates extensions and improvements to the plant and the erection of about 20 miles of wire, covering all parts of Spencer and suburbs, at a cost of about $15,000.

WILLIAMSON, W. VA.—Plans are being considered by the Williamson Lt. & Ice Co. for the construction of an electric-lighting system and an ice and cold-storage plant.

RADFORD, VA.—Application has been made to the Council by Oren Dodds for a franchise to install and operate an electric-lighting plant.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent, Post Office Department, Washington, D. C., until March 23, for furnishing ten electric platform trucks. For further information address J. A. Edgerton, purchasing agent.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of District of Columbia, District Building, Washington, D. C., until March 31 for furnishing cast-iron lamp posts. Specifications and form of proposal may be obtained on application to the purchasing officer, Room 320, District Building, Washington.

WASHINGTON, D. C.—Bids will be received at the office of the secretary of the Commissioners of the District of Columbia, Room 509, District Building, Washington, D. C., until April 3 for heating, plumbing and electric work for the Powell School Building No. 137. Plans and specifications may be obtained from the chief clerk, engineer department, Room 427 District Building, upon deposit of $5.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of District of Columbia, District Building, Washington, D. C., until April 4, for furnishing during the fiscal year beginning July 1, 1916, and ending June 30, 1917, for use of the various branches of the government of the District of Columbia, supplies, including hardware, chemicals, electrical supplies, wheelwright supplies, automobile supplies, oils and lubricants, etc. Form of proposal, specifications and necessary information may be obtained from the purchasing officer, Room 320, District Building, Washington.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Newport, R. I., Schedule 9407—20 engine bodies; Schedule 9413—1500 lb. tubing copper. Philadelphia, Pa., Schedule 9415—one rudder-angle indicator transmitter; Schedule 9427—miscellaneous renewable inclosed fuses, 2000 refillable plug fuses; Schedule 9410—one shear rotary. Brooklyn, N. Y., Schedule 9406—one 4-ton motor truck; Schedule 9427—twenty portable ventilating sets; Schedule 9409—miscellaneous pumps. Washington, D. C., Schedule 9413—600 ft. six pair rubber-insulated cable, 200 steam-tight marine lighting fixtures, miscellaneous electrical supplies, 6000 ft. steel conduit; Schedule 9418—550,000 boiler gaskets for Babcock & Wilcox boilers, to be delivered at the various navy yards. Application for proposals should designate the schedule desired by number.

North Central

BAY VIEW, MICH.—The Bay View Camp Ground Association will soon be in need of some meters, transformers and pole fixtures, etc. C. J. Place is superintendent.

BENTON HARBOR, MICH.—Arrangements are being made by the Benton Harbor, St. Joseph Railway & Light Company, Benton Harbor, for starting a campaign for the sale of electric ranges and equipment for pumping plants on rural line. John A. Cavanaugh is superintendent of light and power department.

CHARLEVOIX, MICH.—Plans are being considered by the municipal electric-light and water-works department for the erection of 1 mile of 23,000-volt transmission line for an auxiliary to the municipal electric plant. A. J. Hamilton is superintendent.

CLINTON, MICH.—A coal conveyor will be installed at the municipal electric-light plant before June 1. Fred E. Ellis is superintendent.

DETROIT, MICH.—A permit has been granted to the Detroit Edison Company for the erection of an addition to its power plant on Second Avenue near Amsterdam Avenue.

DETROIT, MICH.—Plans have been completed for an eighteen-story office for the Highland Park State Bank to be erected at Shelby and Fort Streets. Considerable electrical equipment will be required and an electric power plant may be installed. James Couzens is president of the bank.

DETROIT, MICH.—Estimates are now under consideration by the Public Lighting Commission for the installation of wires and cables for 1600 new arc lamps to be installed during the ensuing year; approximately 800 of these will be connected to underground circuits. Frank R. Mistersky is general superintendent.

EAST JORDAN, MICH.—The East Jordan Electric Light & Power Company is contemplating the installation of a 50-kw. steam turbo-generator, consisting of a 2200-volt generator, with step-up transformers, three-phase, 60 cycles, and steam-pressure 100 lb. to 150 lb. The company would like to receive quotations on steam consumption, operating condensing or non-condensing. L. G. Balch is superintendent.

IRON RIVER, MICH.—The Iron Range Lt. & Pwr. Co. is contemplating rewiring, etc., of substation; also new entrance to substation. M. D. Parks is superintendent.

ISHPEMING, MICH.—The Marquette County Gas & El. Co., Ishpeming, is installing a 1000-kw. turbine, boilers and cooling tower, and is also erecting a transmission line to Palmer to supply electricity to the mines in that vicinity. A. C. Harington is general manager.

KALAMAZOO, MICH.—The contract for the construction of the new mill of the Riverview Coated Paper Company, Kalamazoo, has been awarded to the Frank L. Shoemaker Company, Kalamazoo. The new mill will have a floor space of 206,000 ft. and will be operated entirely by electricity. J. M. C. Billingham is architect, and Felix Pagenstecher is secretary of the company.

LANSING, MICH.—Plans for rebuilding the engineering buildings of the Michigan Agricultural College at East Lansing, recently destroyed by fire, have practically been decided upon. From $150,000 to $175,000 will be available to start the work. Edwyn A. Bowd, architect, has been engaged to prepare plans for the new engineering building.

LOWELL, MICH.—The board of electric light commissioners will rebuild about 7 miles of transmission lines and also rewire power house. It is also proposed to start a campaign advocating the use of electric ranges and electrical cooking and heating apparatus. F. J. McMahon is superintendent.

MARSHALL, MICH.—The installation of a new waterwheel in the municipal electric-light plant next summer to replace the wheels now in use is under consideration. Some changes may possibly be made at the same time in generating apparatus. P. S. Joy is superintendent.

PETOSKEY, MICH.—The purchase of new equipment for the municipal electric-light, plant, including a 300-hp. non-condensing engine, two water-tube or Scotch marine boilers, two waterwheels with gearing and governor, and one 200-kw. alternating-current generator is contemplated. The establishment of an electric-vehicle storage-battery service is also being considered, and a campaign may possibly be started for advocating the use of electricity for heating and cooking purposes. A proposition to purchase additional water-power within the city limits is under consideration. It is estimated that a maximum of 1500 hp. can be developed under an 84-ft. head. J. W. Lovelace is superintendent.

PLAINWELL, MICH.—The Essley Lt. & Pwr. Co., Plainwell, is contemplating the purchase of an exciter and waterwheel governor. Nothing definite yet decided upon.

RAVENNA, MICH.—Steps have been taken by the Ravenna Improvement Association to organize a company to build a hydroelectric plant on the river near Ravenna and to furnish electricity in this village and Conklin.

WHITEHALL, MICH.—The Frugale Power Company of Whitehall, it is reported, is planning to construct a power plant on the north branch of White River in the early spring, to cost about $100,000.

BRADNER, OHIO.—Within the next few weeks the Board of Public Service expects to extend the municipal electric-light service to Prairie Depot, 2½ miles west of Bradner. The municipal electric plant already supplies electricity for lighting the town of Rising Sun, 4 miles to the south. A day service will soon be established in all the towns served by the company. W. B. McCormick is superintendent.

CANAL DOVER, OHIO.—An extra electric generating unit may be installed in the municipal electric-lighting plant. As yet nothing definite has been decided upon. R. A. Murphy is director of public service.

CANTON, OHIO.—Arrangements are being made by the Canton Electric Company for connection with the proposed power plant of the American Gas & Electric Company at Wellsburg, W. Va. The initial installation of the Wellsburg plant will include three turbines of 30,000 kw. each. Work has begun on the erection of the transmission line to Canton.

CINCINNATI, OHIO.—The Union Gas & Electric Company, Cincinnati, contemplates the erection of a new power house and complete transmission system for which plans have been completed. C. W. De Forest is electrical engineer.

CINCINNATI, OHIO.—The Ohio Building & Construction Company has been awarded the contracts for the construction of power houses in connection with the dams on the Ohio River at Ben's Run and Marietta, Ohio, and Woodland, W. Va. The first two will cost about $40,000.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, Room 511, City Hall, Cleveland, until March 24, for ornamental glass globes for park and boulevard lamps for the street-lighting division. Specifications may be obtained at the office of the superintendent of lighting, 413 Superior Avenue, City Hall.

CRESTON, OHIO.—Plans are being considered for extending the municipal electric-lighting service into the rural districts, covering a territory of about 1½ miles. F. D. Knecht is manager.

FELICITY, OHIO.—At an election to be held March 23 the proposal to issue bonds for the installation of an electric-lighting plant will be submitted to the voters.

FRAZEYSBURG, OHIO.—John A. Evans, owner of the local electric-light plant, is contemplating the purchase of a 10-kw. to 12-kw., 220-volt direct-current generator.

LONDON, OHIO.—An ornamental street-lighting system will soon be installed in the business section of the city, to cost about $3,000.

MANCHESTER, OHIO.—About May 1 the Board of Public Works expects to replace ten arc lamps with ten 400-cp. series tungsten lamps; also to purchase regulator to take care of 20 lamps of 400 cp., 10 lamps of 250 cp. and 40 lamps of 100 cp. B. P. Stone is superintendent.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company is contemplating the purchase of a new 3000-kw. turbine with condenser and cooling tower and new 500-kw., 60-cycle rotary converter.

MOUNT ORAB, OHIO.—Bonds to the amount of $4,000 have been voted for the installation of an electric-lighting system in Mount Orab. It is proposed to erect a transmission line from the Cincinnati, Georgetown & Portsmouth Railroad Company at Hamersville to secure electricity to operate the proposed system.

NEW CONCORD, OHIO.—Plans are being considered to increase the output of the municipal electric-light plant. The sale of the plant to a private company is also under consideration. An item published in the issue of Jan. 15 stated that the plant had been purchased by the Ohio Service Company of Cambridge.

OBERLIN, OHIO.—The Oberlin Gas & El. Co. is installing a new pump and a water-treating system. Paul M. Loewe is general manager.

PIONEER, OHIO.—A 2200/110-volt transformer will soon be needed for the municipal electric-light plant. Crosby G. Sweet is clerk of board of public affairs.

READING, OHIO.—The Board of Affairs is contemplating the installation of some underground work in the near future and would like information and prices regarding armored cable and wire. Barrett A. Burns is superintendent of municipal electric-light plant.

ROCKFORD, OHIO.—The Rockford El. Ltg. Co. is erecting an electric transmission line to Mercer and Mendon (a total of 9 miles of new line) and is also installing a new 300-hp. water-tube boiler. The cost of the improvements is estimated at $9,000.

SABINA, OHIO.—The Board of Public Affairs contemplates the purchase of one set of shaking grates and lightning arresters and also household labor-saving devices.

SALEM, OHIO.—Application has been made to the Public Utilities Commission by the Salem Ltg. Co., recently organized, for permission to purchase the properties of the Salem El. Lt. Co. and the Columbiana County Lt. & Pwr. Co., both of which operate in Salem.

ST. PARIS, OHIO.—Plans are being considered for increasing the size of the distribution wires to carry increasing motor load. J. C. Phelps is secretary and superintendent.

SPRINGFIELD, OHIO.—The contract for street-lighting recently awarded to the Springfield Light, Heat & Power Company provides for the installation of a large number of Mazda lamps to replace the arc lamps now in use, of which not less than 175 will be of 240 cp., 392 of 600 cp., and a number of smaller lamps for the parks, etc. The company is to furnish all standards, conduits and other material required.

WINDHAM, OHIO.—The Windham Electric Company is contemplating the purchase of some lightning arresters soon. F. A. Eberwine is secretary and general manager.

WOOSTER, OHIO.—The Wooster Electric Company is planning to install an additional turbine engine and other equipment. C. V. Hard is president.

BOWLING GREEN, KY.—The Kentucky Public Service Company, Bowling Green, contemplates the installation of two Allis-Chalmers 625-kva., 2300-volt turbines and Alberger condensers at its Bowling station, and one Westinghouse 1000-kva., 2300-volt turbine and Alberger condenser at the Hopkinsville plant. H. D. Fitch, Bowling Green, is general manager.

CAMPBELLSVILLE, KY.—The Campbellsville Public Utilities Company is considering the installation of a 150-hp. engine. L. A. Taylor is superintendent.

CARLISLE, KY.—The Carlisle Electric Light & Power Company is erecting a new ice plant. All machinery has been contracted for.

LONE OAK, KY.—The Home Electric Company, Paducah, has applied for a franchise to install and operate an electric-lighting system in Lone Oak. Post office address, Lone Oak, R. F. D. from Paducah.

LOUISVILLE, KY.—Bids will be received at the United States Engineer Office, 425 Custom House, Louisville, until May 6 for the privilege of leasing from the United States certain land and surplus water for power purposes at Grand Rapids dam on Wabash River, near Mount Carmel, Ill. Further information upon application.

MAYFIELD, KY.—The City Council has passed an ordinance authorizing a bond issue to provide funds for the purchase of the property of the Mayfield Wtr. & Lt. Co.

MORGANFIELD, KY.—The right-of-way has been secured by the Morganfield Uniontown Electric Railroad Company for the construction of an electric railway from Morgantown to Uniontown. S. B. Anderson and Walter B. McLean, Memphis, are interested in the project.

NEWPORT, KY.—The Newport & Covington Ry. Co., it is reported, is contemplating the construction of a power house. G. D. Miller, Huntington, W. Va., and associates are interested.

PRESTONBURG, KY.—The capital stock of the Prestonburg Electric Light Company has been increased from $10,000 to $25,000.

PRINCETON, KY.—The Princeton Lt. & Pwr. Co. has purchased the franchise providing for the distribution of electricity for lamps and motors in Caldwell County outside of the city of Princeton.

COLUMBUS, IND.—The County Commissioners have accepted plans for a new lighting system for the court house and jail. The plans provide for other repairs, the cost of which with lighting system is estimated at $7,000.

EVANSVILLE, IND.—Proposals to furnish electricity in Evansville from a plant to be erected on the Wabash River near Mount Carmel, Ill., have been submitted to local business men by Leon H. Murray, engineer in charge of maintenance of way for the Oil Belt Railroad, and B. H. Kamp of Mount Carmel.

GARY, IND.—The construction of a new tube plant at Gary, to cost about $25,000,000, has been announced by the United Steel Company. The work will include ore docks, ore yards, blast furnaces, convert-

ing mills, blooming mills, power station, water-works, sheared-plate mill, universal plate mill, continuous mills, lap-plate mills, butt mills, job shops, and all auxiliary departments. The plant, it is probable, will be built in two sections, the first of which, it is expected, will be completed in about fourteen months.

MUNCIE, IND.—The Muncie El. Lt. Co. is contemplating the erection of about 16 miles of transmission lines. Thomas F. English is general manager.

WESTPORT, IND.—At an election to be held March 21 the proposal to establish a municipal electric-light plant will be submitted to the voters.

ALEDO, ILL.—The installation of an additional generating unit is contemplated by the Tri-County Light & Power Company of Aledo.

EAST ST. LOUIS, ILL.—The Board of Education has decided to install an electric-power plant to supply electricity for the new high school, the old high school and the Horace Mann School. Bids, it is understood, will soon be asked for installation of the plant.

MATTOON, ILL.—The Central Illinois Pub. Ser. Co., Mattoon, has applied for a certificate of convenience and necessity to erect an electric transmission line from Augusta to Clayton and to furnish electrical service in the cities of La Prairie, Golden, Clayton and Camp Point; also to construct and operate an electric lighting and power system in the village of Warrensburg.

MONMOUTH, ILL.—The Central Illinois Public Service Company of Mattoon is contemplating the installation of an additional 300-kw. to 500-kw. generating unit this summer in the local plant and the construction of a 20-ton ice plant this fall. The company has recently completed a transmission line to Roseville, 12 miles long, where it will supply energy in bulk to the Central Illinois Public Service Company.

MOUNT CARMEL, ILL.—An option has been obtained by the Oil Belt Railroad Company for the development of a power site at the Grand Rapids dam above Mount Carmel. Power will be developed for industrial as well as traction purposes.

STRONGHURST, ILL.—M. F. T. Schierbaum, proprietor of the local electric-light plant, is contemplating (not at present) the installation of a new generator, possibly 40 kw. to 50 kw., revolving field, single-phase or three-phase, 2300 volts. As yet no definite plans have been made.

TOULON, ILL.—The Toulon Lt. & Pwr. Co. is contemplating changing its system from direct-current to alternating-current system. If the change is decided upon a new alternating-current generator, switchboard, boilers and transformers will be required. As yet nothing definite has been decided upon. Miles C. Fuller is manager.

LA CROSSE, WIS.—The State Railroad Commission has granted the Wisconsin-Minnesota Light & Power Company, La Crosse, permission to issue $150,000 in bonds to pay for improvements and extensions to its property in this State.

MANITOWOC, WIS.—The State Railroad Commission has authorized the Oslo Power & Light Company, Manitowoc, to issue $5,000 in capital stock, the proceeds to be used for improvements to its plant.

MANITOWOC, WIS.—The utility committee of the City Council has recommended that the city ask for bids at once for the new electric equipment for the combined electric-light and power plant for which plans have been prepared by City Engineer Pitz. The equipment is to include a 750-kw. turbo-generator and a 500-kw. generator.

OSHKOSH, WIS.—Plans are being prepared for the installation of a new street-lighting system in Oshkosh. Ornamental lamps are to be erected in the business district and arc lamps in the residential section. William A. Baehr, 122 South Michigan Avenue, Chicago, Ill., is consulting engineer, and George Randall is city engineer.

PRAIRIE DU SAC, WIS.—Options, it is reported, have been secured on property at Madison, Prairie du Sac and Portage for the erection of a 15,000-kw. power plant, to cost about $500,000. Woodmansee & Davidson of Chicago, Ill., are consulting engineers.

SHAWANO, WIS.—Bids will be received by the Electric Light and Water Works Commissioners of Shawano until March 28 for construction of a concrete dam, 230 ft. long and 13 ft. high, with concrete flumes, draft tubes, core walls and abutments, brick power house and earth dikes, as per plans and specifications on file in the office of the city clerk, Shawano, or at the office of the Power Engineering Company, Corn Exchange Building, Minneapolis, Minn.

WALWORTH, WIS.—The local electric-light plant, it is reported, has been purchased by the Southern Wisconsin Electric Company of Lake Geneva, which will erect a 33,000-volt transmission line to Walworth this spring.

BUTTERFIELD, MINN.—The installation of an electric-light plant in Butterfield is under consideration.

DASSEL, MINN.—A franchise has been granted to the Public Service Company of St. Cloud to construct and operate electric transmission lines in Dassel.

ST. PAUL, MINN.—Bids will be received by August Hohenstein, purchasing agent, St. Paul, until March 27 for furnishing two motor-driven pumping units, each having a capacity of 5000 U. S. gal. per minute against a total combined head of 171 ft.

WADENA, MINN.—The City Council is considering a bond issue for the installation of an electric-light plant.

DUBUQUE, IOWA.—The Chicago, Milwaukee & St. Paul Railroad, it is reported, has closed contracts with the Union Electric Company of Dubuque to equip the railroad shops of the company here for electrical operation.

MECHANICSVILLE, IOWA.—The installation of an electric-lighting plant in Mechanicsville is reported to be under consideration.

MUSCATINE, IOWA.—The Muscatine Ltg. Co., it is reported, is contemplating installing new equipment, including new boilers, steam turbine and condensers, in its emergency station, to cost from $25,000 to $30,000.

MEMPHIS, MO.—Bonds to the amount of $25,000 have been voted for the installation of a municipal electric-lighting plant. David G. Fisher & Company, Davenport, Iowa, are engineers.

MOUNT VERNON, MO.—Bonds to the amount of $8,500 have been voted for improvements to the municipal electric-light plant.

BOWMAN, N. D.—The Bowman Electric Light & Power Company is planning to install a 100-kw. turbo-generator (2300 volts, 60 cycles), transformers, poles, wire and meters. The installation of a new plant at a town near Bowman in the spring is under consideration by the company. An item published in the issue of Jan. 29 stated that the company has purchased new equipment for its plant. W. R. McKenzie is president and manager.

ELLENDALE, N. D.—The Ellendale El. Co. is contemplating the erection of a transmission line to Frederick.

FORDVILLE, N. D.—An electric-lighting system, it is understood, will be installed in Fordville in the near future.

STANLEY, N. D.—Preliminary plans and estimates of costs for water-works, electric-light plants and sewers for four towns are being prepared by C. J. Donaldson, consulting engineer, Stanley. Mr. Donaldson would like catalogs, price lists, etc., on all equipment and supplies used in connection with electric-lighting plants, water-works and sewer systems.

ALCESTER, S. D.—Bonds to the amount of $10,000 have been voted for the installation of a municipal electric-lighting plant.

ARMOUR, S. D.—The Interstate Pwr. Co., Armour, has recently completed the erection of a single-phase, 33,000-volt transmission line to Parkston. Option has been taken on the electric plant in Tripp, and the company probably will connect that town with its transmission system early in the summer. J. H. Duncan is vice-president and manager.

ELK POINT, S. D.—Improvements and extensions are contemplated to the municipal electric-light plant and water-works system, for which $15,000 in bonds have been sold.

FAULKTON, S. D.—The Faulkton Light & Power Company contemplates the installation of two new additional generating units. It also proposes to establish a twenty-four-hour service. Oscar Edwards is manager.

HURLEY, S. D.—The Hurley Light Company is contemplating installing a 10,000 gal. tank to store distillate in carload quantities and also a 10-hp. or 12-hp. oil engine. H. E. Dunn is manager.

MITCHELL, S. D.—The installation of a 350-hp. Diesel engine and a 260-kva. generator this summer is contemplated by the Mitchell Power Company. E. J. Sherwood is manager.

VERMILION, S. D.—The electric-light commissioners are contemplating rebuilding the entire transmission line and installing electroliers on Main Street. R. W. Nash is superintendent.

FULLERTON, NEB.—The plant of the Fullerton Electric Light & Power Company was recently destroyed by fire, causing a loss of about $30,000.

GREENWOOD, NEB.—T. J. Marshall, Greenwood, is building an electric-light plant and ice factory in this city.

OAK, NEB.—The Meyer Hydro-Electric Power Company, Oak, recently incorporated with a capital stock of $10,000, is furnishing electrical service in the towns of Edgar, Davenport, Carleton and Ruskin, where it has twenty-five-year franchises and lighting contracts for five and ten years. Six other towns and villages have applied to the company to supply electrical service.

SCOTTSBLUFF, NEB.—Messrs. Wilkinson & Vandees of Denver, who have purchased the property of the Cross & Roberts Electric Light Company, it is reported, contemplate improvements to the electric plant, to cost about $50,000, and also the construction of an electric railway from Scottsbluff to Gering.

TRENTON, NEB.—The proposal to establish a municipal electric-lighting plant in Trenton will be submitted to the voters at the spring election.

BELOIT, KAN.—The installation of a coal-handling system and apparatus for coal burning instead of oil is under consideration by the light and water department; it is also estimating the cost of a "Unaflow" engine of about 200 hp. A new street-lighting system is being installed. F. A. Darst is superintendent.

BUCKLIN, KAN.—Connection will be made with the transmission line of the Midland Water, Light & Ice Company from Dodge City, about June 1. G. W. Aelwein is superintendent.

CHANUTE, KAN.—The Public Utilities Commission is installing a new 250-kva. Skinner "Unaflow" engine and erecting a 2300-volt transmission line, 2 miles long, to supply energy to operate the city pumping station. W. M. Barber is commissioner of public utilities.

DENNISON, KAN.—The City Council is considering the installation of a municipal electric-light plant. Energy to operate the system will be obtained from the municipal electric plant at Holton.

GARDNER, KAN.—Plans are being considered for the installation of a municipal electric-lighting plant in Gardner.

HAVEN, KAN.—The Haven El. Lt. & Ice Co. expects to make connection in June with the transmission line which furnishes energy to the interurban railway, which will enable it to give a 24-hour service. The installation of an ornamental street-lighting system is under consideration, but as yet nothing definite has been decided upon.

OTTAWA, KAN.—Plans are being considered for the installation of two 200-kw. to 250-kw. turbo-generator units in the municipal electric-light plant. W. O. Myers is superintendent.

PRATT, KAN.—At an election to be held April 4 the proposal to issue $23,000 in bonds for improvements to the municipal electric-lighting plant will be submitted to the voters.

Southern States

CHARLOTTE, N. C.—The Southern Pwr. Co., Charlotte, it is reported, is taking options on land on the eastern slope of the Blue Ridge Mountains with a view of constructing a large storage dam for its various plants on rivers heading in that watershed.

HILLSBORO, N. C.—The Hillsboro Power & Light Company, recently organized, proposes to install and operate an electric-lighting system in Hillsboro. Energy will be purchased from the Southern Power Company. H. S. Cates is president.

LA GRANGE, N. C.—The H. H. Sutton & Son Electric Light Company, La Grange, is in the market for a 35-kw. to 50-kw., three-phase, 60-cycle generator. A good second-hand machine will be considered. A. R. Sutton is manager.

MARSHALL, N. C.—The Capitola Mfg. Co. is planning to construct a hydroelectric plant providing for a development of 1200 hp. It is proposed to replace the present plant, consisting of a log-stone dam and 250-kw. turbine, with a concrete or masonry dam. As yet definite plans have not been made or an engineer engaged.

NASHVILLE, N. C.—Bonds to the amount of $45,000 have been authorized, the proceeds to be used for the installation of electric-light plant, water-works and sewer system.

UNIVERSITY, N. C.—Authority has been granted the University of North Carolina to borrow $10,000 to complete a $40,000 fund for the installation of a lighting and heating plant to replace the present system.

WEAVERVILLE, N. C.—The Weaver El. Co. expects to install three 5-kw., five 2-kw. and three 1-kw., 2200/110-volt transformers. John V. Erksine is lessee.

ZEBULON, N. C.—An election will be called to submit to the voters the proposal to issue $10,000 in bonds for the installation of a municipal electric-lighting plant.

HONEA PATH, S. C.—Within the next twenty or thirty days the electric light commission will require for connection with lines of the Southern Power Company one 10-kw., three-phase, 60-cycle, 2300-volt regulator, two watt-hour meters, two 2300/110-volt transformers, 900 lb. No. 4 weatherproof copper wire and one three-pole double-throw oil circuit-breaker, 12,000 volts. J. A. Featherston is superintendent.

ATLANTA, GA.—F. E. Markel, Atlanta, Ga., has been engaged by Barnwell & Barnwell, Chattanooga, Tenn., architects, for the new office building (12 stories high, 125 ft. by 90 ft.) to be erected for the Volunteer State Life Insurance Company in Atlanta, to prepare designs and specifications for mechanical work for the building.

MELBOURNE, FLA.—The Peninsular Engineering & El. Co., St. Petersburg, is contemplating the installation of an electric-light plant and ice factory in Melbourne.

NASHVILLE, TENN.—The Nashville, Hartsville & Red Boiling Springs Railway Company, recently incorporated, is contemplating the construction of a railway from Hartsville through Lafayette to the springs. The company is capitalized at $50,000. John C. Shofer and Howard Andrews are interested.

FAYETTE, ALA.—Arrangements are being made for the installation of an electric-lighting plant and ice factory, for which, it is understood, machinery has been ordered. Thomas H. Robertson is reported interested in the project.

CAMDEN, ARK.—The Arkansas Lt. & Pwr. Co., Little Rock, it is reported, will overhaul and increase the output of its local plant.

CUSHING, OKLA.—The Minnesota Electric Light & Power Company, Cushing, is contemplating the installation some time in the future of a 350-kva., three-phase, 60-cycle, 2300-volt generator directly connected to a simple Corliss engine, with switchboards and necessary accessories. D. G. Lewis is manager.

FORT COBB, OKLA.—The installation of a municipal electric-lighting plant in Fort Cobb is under consideration.

OKLAHOMA CITY, OKLA.—A building for power, heating, lighting, water, ice and laundry plants will be erected by the Huckins Hotel.

STROUD, OKLA.—Plans are being prepared by the Benham Engineering Company, Oklahoma City, for reconstruction of lighting and water systems, for which bonds to the amount of $20,000 have been issued.

BELTON, TEX.—Plans are being considered, it is reported, by the Texas Power & Light Company, Dallas, for the reconstruction of the municipal electric-light plant in Belton.

CENTER, TEX.—The Texas Southern Electric Company, which has taken over the property of the Pittman Ice & El. Co., is planning to overhaul the plant and rebuild distributing lines, for which material has been purchased. A twenty-four-hour service will soon be established. M. E. Pittman is manager.

COOPER, TEX.—The Cooper El. Co. is contemplating the erection of two transmission lines to Klondike and Enloe, each 5 miles long. E. D. Broadhead, secretary and manager.

DALLAS, TEX.—The City Commission has called an election to be held April 4 to submit to the voters the proposal to issue $500,000 in bonds for the construction of a municipal electric-light plant.

KILLEEN, TEX.—The City Light & Power Company, Killeen, is installing Duncan meters throughout the town. When completed the company will discard its flat-rate service. F. E. Grubbs is manager.

LONGVIEW, TEX.—The Longview Ice & Light Company contemplates the erection of a high-tension transmission line, 23 miles long, connecting the Longview and Marshall plants. W. B. McNaughton is manager.

MARLIN, TEX.—The construction of an interurban electric railway between Marlin and Waco, a distance of about 35 miles, is being promoted by C. C. Moser of Dallas and associates.

NAVASOTA, TEX.—The Navasota Ice, Light, Power & Water Company contemplates the construction of a new ice and cold storage (brick) plant, to cost about $15,000. R. W. Horlock is manager.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company, New Braunfels, is in the market for an auxiliary 500-hp. generating unit, either steam or oil engine, with or without attached generator. H. Landa is president.

RIO GRANDE, TEX.—The installation of an electric-light plant in Rio Grande is under consideration. C. Valle & Brothers are reported interested in the project.

SABINAL, TEX.—The Sabinal Water & Ice Company is contemplating improvements to its system. New equipment will include cedar poles, 25, 40, 60 and 100-cp. lamps, one two-stage centrifugal pump, 250 gal. per minute, under 160 ft. head, and motor. F. E. Thompson is president.

SEGUIN, TEX.—The Seguin Electric Light & Power Company is installing and expects to complete about April 15 one 187-kva., three-phase generator and two 52-spiral Trump turbines; also a new reinforced concrete power house and penstocks. The company expects to push the sale of heating and cooking apparatus, especially electric ranges. Owen A. Gafford is manager.

SHERMAN, TEX.—The water and light department is now installing Mazda street lamps, replacing arc lamps now in use. George Stephens is manager.

TERRELL, TEX.—The Terrell El. Lt. Co. is contemplating the erection of an electric transmission line from Forney to Terrell and Kaufman. M. A. Joy is president.

UVALDE, TEX.—The Uvalde Electric Light Company has closed a contract with the Fairbanks-Morse Company for new equipment for its plant, including a 75-hp. crude engine, Diesel type, directly connected to a 55-kva. generator.

VALLEY MILLS, TEX.—The installation of an electric-lighting system in Valley Mills is under consideration. Mr. Miers of Dawson is reported to be interested in the project.

Pacific States

TACOMA, WASH.—The Park Board has petitioned the City Council to install ornamental lamp standards in Wright and Point Defiance Parks. Residents on South Ainsworth Street have petitioned the Council for the installation of ornamental lamps on that thoroughfare from Steele Street to South Sixteenth Street.

MEDFORD, ORE.—Arrangements, it is reported, have been made by the California-Oregon Power Company for securing funds for the completion of its large power project at Capco on the Klamath River, for doubling the output of its Prospect plant, and for extensions of transmission lines to mining and timber districts. J. D. Grant of San Francisco, Cal., is president, and John D. McKee of Medford is vice-president.

NORTH BEND, ORE.—The electric plant of the Oregon Power Company in North Bend was recently damaged by fire, causing a loss of about $5,000.

ROSEBURG, ORE.—A. Welch, formerly president of the Douglas County Light & Water Company of Roseburg, has sold his interest in the company to John Kiernan of Portland. The deal also included one-half of the stock of the Seaside (Ore.) Light & Power Company. Extensive additions and improvements, it is understood, will be made to the local plant. William Pollman of Baker is president.

ALTURAS, CAL.—The State Railroad Commission has authorized the Alturas Electric Power Company to issue $90,000 in bonds. Of the proceeds $17,265 is to be used for improvements to its plant and the remainder for refunding purposes.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has applied to the State Railroad Commission for permission to increase its capital stock from $3,500,000 to $6,000,000 and to sell $500,000 in stock.

SAN FRANCISCO, CAL.—The public utilities committee of the Board of Supervisors has voted to recommend setting aside $275,000 for construction of tracks and overhead trolley system from Twin Peaks Tunnels, Market Street entrance, to junction of Sloat and Junipero Serra Boulevards.

TALMAGE, CAL.—Bids will be received by W. F. McClure, state engineer, Forum Building, Sacramento, until March 28 for electric elevators (dumbwaiters) for the Mendocino State Hospital at Talmage. Specifications may be obtained from the department of engineering, Sacramento, upon deposit of $10.

EPHRAIM, UTAH.—The electric light commission has recently completed the erection of an electric transmission line into a farming district for furnishing electricity for operating pumps for irrigation purposes. If the service is satisfactory, considerable line extensions will be made this year. J. H. Jensen is superintendent.

TROY, MONT.—The power site and water rights of the Lake Creek Falls power project have been purchased by Leo Greenough and associates, who control the Banner and Bangle mines south of Troy. Power generated at the Lake Creek power site will be used to operate the electric line to the mines and machinery in the mines.

BUENA VISTA, COL.—W. P. Eyre, owner of the local electric-light plant, contemplates changing over immediately a 500-volt heavy copper direct-current transmission line, 1½ miles from town, to alternating current. Other extensions and improvements are contemplated but are awaiting power sales developments, now pending.

ALAMOGORDO, N. M.—The City Council has entered into a tentative contract with the Alamogordo Light & Power Company, the Alamogordo Water Works Company and the Alamogordo Improvements Company to take over the properties of the three companies for a total consideration of $300,000. The contract will be submitted to the approval of the voters on April 4. If taken over by the city, improvements will be made to the plants.

Canada

ST. JOHN, N. B.—Application will be made to the Legislature for a charter for the St. John River Hydroelectric Co., with power to acquire and develop a water-power on the St. John River at or near Pokiok.

FORT FRANCES, ONT.—The street-lighting system is gradually being changed from arc lamps to "Luxolite" lamps. It is proposed to install a 2000-volt, 60-cycle watt-hour meter at substation. The installation of an electric motor and pump for use of fire department, to maintain 125 lb. pressure on eight lines of hose, 1⅛-in. nozzle, is under consideration. H. A. Sands is superintendent of the municipal electric-light plant.

TORONTO, ONT.—Hon. G. Howard Ferguson, Minister of Lands, Forests and Mines, announces that the government has signed an agreement with the Electric Power Company, which controls what are generally known as the Seymour enterprises, purchasing outright all the interests of that corporation, including water-powers, development plants, transmission lines, local water and light companies and an electric railway, at $8,350,000. Twenty-two companies have been taken over, including the Auburn Power Company, the Central Ontario Power Company, City Gas Company, Oshawa; Cobourg Utilities Corporation, Cobourg Electric Company, Cobourg Gas, Heat & Water Company, Eastern Power Company, Lindsay Light, Heat & Power Company, Napanee Gas Company, Napanee Water & Electric Company, Northumberland Pulp Company, Oshawa Electric Light Company, Otonabee Power Company, Peterborough Light & Power Company, Peterborough Radial Railway Company, Port Hope Electric Light & Power Company, Seymour Electric Power Company, Sydney Electric Power Company, Trenton Electric Power Company, Tweed Electric Light & Power Company, Nipissing Power Company, and North Bay Light, Heat & Power Company. By taking over the Seymour interests the government, through the Hydro-Electric Power Commission, will be able to serve municipalities as far east as Kingston, and the commission will make provision at once for extending transmission lines to all municipalities asking for Hydro-Electric service. Under the arrangement not only central Ontario but also North Bay and the Nipissing district will be served by the Hydro-Electric Power Commission.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until March 24 for furnishing soft steel, sheet steel, cable, sheet lead, brass tubing, lead pipe, etc. For further information address Major Earl I. Brown, general purchasing officer.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until March 31, for steel, steel plates, cold-rolled steel, steel cable, electric cable, steel wire, steel and iron pipe, wire lath, electric motors, lathe, band saws, dies, fusible plugs, spark plugs, grease cups, oil cups, priming cups, water-gage lamps, etc. Blanks and general information relating to this circular (No. 1022) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,174,044. X-RAY APPARATUS; E. Benson, Newton Highlands, Mass. App. filed May 5, 1915. More effective cathode and target construction.

1,174,053. INDUCTANCE REGULATOR FOR ALTERNATING-CURRENT CIRCUITS; M. Burns, Evansville, Ind. App. filed Dec. 23, 1914. Practically designed for motion-picture machines.

1,174,078. CABLE TERMINAL BOX; J. A. McCoy, Somerville, Mass. App. filed March 7, 1911. Includes an outer container casing and an inner distributing casing.

1,174,104. DYNAMO MACHINE AND APPARATUS; W. A. Turbayne, Lancaster, N. Y. App. filed Jan. 29, 1910. Reversible "booster" construction.

1,174,105. ELECTROPNEUMATIC BRAKE; W. V. Turner, Edgewood, Pa. App. filed Oct. 6, 1914. Limits rate of reduction in brake-pipe pressure when brake is electropneumatically applied.

1,174,129. ANNUNCIATOR; F. J. Doherty, Camden, N. J. App. filed June 3, 1915. Improved "drop" construction.

1,174,142. DOOR-CONTROLLED CIRCUIT-BREAKER; H. Harris, Buffalo, N. Y. App. filed Dec. 17, 1914. For railway cars.

1,174,145. IGNITER; A. B. Herrick, New York, N. Y. App. filed Nov. 29, 1912. Induction mechanism operated by pressure in engine cylinder.

1,174,146. ELECTRIC MINER'S LAMP; W. Hickmann, Greisheim, Germany. App. filed July 17, 1911. Two dry cells in series having different conditions of emf. for each supply period.

1,174,149. THERMOSTATIC CONTROLLER; V. Himmer, Jr., Bayonne, N. J. App. filed March 25, 1913. Operates by expansion and contraction of body of air.

1,174,162. ELECTRICAL SWITCH; M. H. Johnson, Utica, N. Y. App. filed Dec. 26, 1911. For automobiles and the like; has a removable plug.

1,174,187. LOADING COIL; T. Shaw, Hackensack, N. J. App. filed Nov. 5, 1914. Constructed to reduce electromagnetic and electrostatic "cross-talk."

1,174,200. INSPECTING INSTRUMENT; O. F. Tallman, St. Louis, Mo. App. filed April 11, 1914. Of simple construction, particularly for telephone cables.

1,174,225. SPARK COIL; D. M. Bliss, West Orange, N. J. App. filed Dec. 7, 1910. Novel form of laminations held in place by casing.

1,174,230. RELAY; C. W. Coleman (deceased), Westfield, N. J. App. filed May 7, 1909. Reed type; maintains circuit closed only when current is of definite frequencies.

1,174,236. CONTROLLING SYSTEM; A. F. Dixon, Newark, N. J. App. filed March 16, 1914. Perforated-tape system.

1,174,246. SUPPORT FOR ELECTRICAL DISTRIBUTION DEVICES; J. L. Fay, St. Louis, Mo. App. filed Aug. 2, 1913. For supporting transformer and fuse box on pole.

1,174,252. ELECTRIC-HEATING ELEMENT; A. H. Happe and W. J. Keep, Detroit, Mich. App. filed June 17, 1915. Armored; for use in electric ranges.

1,174,262. TELEPHONE SYSTEM; E. H. Martin, Webster City, Iowa, and T. H. Ferguson, Oak Park, Ill. App. filed Jan. 26, 1914. Indicates to subscribers when compensation has reached a given period of time.

1,174,281. TELEGRAPH SYSTEM; P. M. Rainey, Glen Ridge, N. J. App. filed Dec. 7, 1914. Automatic distribution of incoming calls to idle operators.

1,174,287. INSULATOR SUPPORT; M. C. Rosenfeld, Cleveland, Ohio. App. filed Jan. 6, 1913. Post and insulator may be conveniently adjusted without removing the post from its support.

1,174,293. CONTROLLER; J. E. Seeley, Los Angeles, Cal. App. filed Nov. 30, 1914. High-tension; eliminates arcing from sliding contact, current being cut off during movement of contacts.

1,174,337. INTEGRATING MECHANISM; E. H. Messiter, Brooklyn, N. Y. App. filed Feb. 19, 1910. Continuous weighing of material carried by traveling conveyor.

1,174,338. REGULATION OF DYNAMO-ELECTRIC MACHINES; A. H. Midgley and C. A. Vandervell, Acton Vale, England. App. filed Oct. 10, 1913. Battery-charging system.

1,174,367 SHIP'S ELECTRIC RANGE; F. M. Vogel, Pittsfield, Mass. App. filed June 12, 1913. Readily cleaned and protected from injury by grease or the like.

1,174,373. MOTOR REGULATION; E. A. Wright, Norwood, Ohio. App. filed Aug. 23, 1911. Induction motor drives a variable load at substantially constant but adjustable speed.

Record of Electrical Patents

Notes on United States Patents issued March 7, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,174,379. SWIVEL CONNECTION FOR ELECTRIC CONDUCTORS; W. S. Bacon, San Diego, Cal. App. filed April 10, 1915. Designed for insertion in a telephone line, or the like.

1,174,383. CROSSING SIGNAL; L. S. Brach, New York, N Y. App. filed Jan. 4, 1912. Simulates the swinging of a lantern.

1,174,421. LIGHT SOCKET; W. J. Howe and J. M. Pearring, San Diego, Cal. App. filed Dec. 12, 1914. Locking washer engages inner edge of bulb inserted in socket.

1,174,427. APPARATUS FOR FORMING TELEGRAPH TAPE; C. L. and H. L. Krum, Chicago, Ill. App. filed June 18, 1912. Electromagnetically controlled apparatus for punching tape.

1,174,434. TELEPHONE PAY STATION; G. E. Mueller, La Grange, Ill. App. filed Dec. 7, 1907. A single magnet controls the collection or return of the coin.

1,174,443. ELECTRIC WATER HEATER OR GEYSER; J. R. Quain, London, England. App. filed July 11, 1914. Valve operates heater switch but has a movement independent of the switch.

1,174,444. HEATER FOR MINING AND FOR OTHER PURPOSES; J. R. Quain, London, England. App. filed March 16, 1915. Electric heater adapted to be driven into the ground.

1,174,446. ELECTRIC METAL-WORKING APPARATUS; A. F. Rietzel, Charlestown, R. I. App. filed Aug. 29, 1911. Simulates the work of a skilled operator.

1,174,450. TRACK RELAY FOR BLOCK SIGNAL SYSTEMS; J. J. Ruddick, Newton, Mass. App. filed Dec. 26, 1913. Applied to system wherein each block has two insulated rail sections.

1,174,451. AUTOMATIC TRAIN STOP; H. G. Sedgwick, Mill Valley, Cal. App. filed Dec. 24, 1908. Disruption of the normally dead wire disrupts the normally live wires.

1,174,492. BELL AND SWITCH OPERATING MEANS; J. G. Glover, Lachine, Quebec, Canada. App. filed April 23, 1915. Push-button also operates a lamp-lighting push-button switch in the house.

1,174,503. AUTOMATIC FIRE-ALARM SYSTEM; J. M. Johnson, Kansas City, Kan. App. filed Oct. 28, 1912. Location of fire automatically indicated at central station.

1,174,521. ELECTRIC LANTERN; N. S. Richmond, Chicago, Ill. App. filed March 30, 1914. Lamp carried by cover applied to ordinary dry cell.

1,174,545. TWO-STROKE-CYCLE INTERNAL-COMBUSTION ENGINE; W. H. Butterfield, Stechford, Birmingham, England. App. filed July 30, 1914. Armature of magneto is coupled directly to engine crankshaft.

1,174,548. ELECTRICAL ELEMENT; F. J. Cook, Cleveland, Ohio. App. filed March 25, 1914. Conserves and concentrates radiation of heat in a given direction.

1,174,554. THERMIC TELEPHONE; O. Fischer, Utrecht, Netherlands. App. filed March 19, 1914. Protects the Wollaston wires when dipping them in the acid.

1,174,563. DYNAMO-ELECTRIC MACHINE; A. E. Glass and J. M. Downer, Schenectady, N. Y. App. filed May 2, 1914. Conductor bar connected to short-circuiting rings in a manner to avoid harm from expansion and contraction.

1,174,570. RESISTANCE DEVICE; E. A. Halbleib, Rochester, N. Y. App. filed June 14, 1915. Novel mounting of porcelain core and inclosing shell.

1,174,571. BATTERY AND SWITCH CASING; E. A. Hawthorne, Bridgeport, Conn. App. filed Aug. 9, 1913. Especially designed for motorcycles.

1,174,573. AUTOMOBILE SIGNALING DEVICE; W. F. Hoefs, Milwaukee, Wis. App. filed June 19, 1915. Signal elements normally protected in a housing.

1,174,599. TELEPHONE PAY STATION; G. E. Mueller, Aurora, Ill. App. filed Dec. 7, 1907. Polarized magnet controls the distribution of the coin.

1,174,600. CONDENSER; W. J. Murdock, Everett, Mass. App. filed Feb. 7, 1911. Particularly designed for radiotelegraphy.

1,174,607. INSULATOR SUPPORTING PIN; C. L. Pierce, Jr., Pittsburgh, Pa. App. filed May 4, 1914. Formed from integral body of steel.

1,174,613. CONTRIVANCE FOR TRANSMITTING SOUND TO SOLID SOUND CONDUCTORS; E. Ruhmer, Berlin, Germany. App. filed Feb. 20, 1913. Telephone diaphragm causes to vibrate a solid sound conductor.

1,174,654. ALTERNATING-CURRENT MOTOR; S. R. Bergman, Lynn, Mass. App. filed Oct. 4, 1913. Speed of motor controls current flowing in secondary winding.

1,174,667. PROCESS OF FIXING NITROGEN AND ELECTRIC FURNACE FOR EFFECTING THE SAME; J. E. Bucher, Coventry, R. I. App. filed June 25, 1914. Electric furnace having a resistor including a catalyzer.

1,174,676. VACUUM VALVE TUBE; E. W. Caldwell, New York, N. Y. App. filed May 14, 1914. Uses cathode having a large effective diameter or capacity.

1,174,678. BRAKE MECHANISM; H. A. Carpenter and A. W. Warner, Sewickley, Pa. App. filed Oct. 30, 1914. Friction-disk type, for electric motors.

1,174,686. REFILLABLE FUSE PLUG; J. G. Clemens, Buffalo, N. Y. App. filed May 25, 1915. No solder required.

1,174,714. HEATING SYSTEM; G. E. Harrison and J. Templeton, Toronto, Ontario, Canada. App. filed Jan. 29, 1915. Independently controlled electric radiators placed in different rooms.

1,174,715. ELECTROLYTIC ELECTRICITY METER; H. S. Hatfield, Brunswick, Germany. App. filed June 7, 1913. Constructed to prevent detachment by the mercury anode.

1,174,726. RADIOTELEGRAPHY; C. Horton, New York, N. Y. App. filed July 29, 1913. Improved "coupler" adapted for wide range of resonant adjustment.

1,174,742. IGNITION AND CHARGING SYSTEM; S. L. Lebby, Charleston, S. C. App. filed June 3, 1914. Separately excited field adapts the system for units of large size.

1,174,760. CONTROLLING SYSTEM FOR CONVEYING MEANS; A. C. Philpott, Bucyrus, Ohio. App. filed Jan. 8, 1914. Automatically shifts oppositely moving cars on to sidings.

1,174,772. SYSTEM OF MOTOR CONTROL; M. Steiner, Berlin, Germany. App. filed Dec. 10, 1914. For rolling-mill motors.

1,174,793. METHOD OF FREQUENCY TRANSFORMATION; E. F. W. Alexanderson, Schenectady, N. Y. App. filed July 29, 1913. Improved method of obtaining the second, third and higher harmonics of the fundamental and higher frequency of an alternating current.

1,174,798. GALVANIC CELL; V. G. Apple, Dayton, Ohio. App. filed Nov. 19, 1914. Dry cell with elements within waterproof casing, water being supplied when ready for use.

1,174,807. PNEUMATIC ACTION; W. G. Betz, Buffalo, N. Y. App. filed May 20, 1914. Simple construction, sensitive and quick-acting.

1,174,809. ELECTRIC CONDUIT FITTING; C. H. Bissell, Syracuse, N. Y. App. filed Feb. 11, 1910. For inclosing fuse boxes and the like.

1,174,810. SIGNALING DEVICE; J. H. D. Blanke, Le Mars, Iowa. App. filed July 25, 1914. Centrifugally controlled element signals when vehicle is coming to a stop.

1,174,813. ELECTROMAGNETIC MUSICAL INSTRUMENT; G. Breed, Philadelphia, Pa. App. filed March 29, 1912. Automatic player-piano as means for exciting particular electromagnets to emphasize notes.

1,174,827. CIRCUIT-CLOSER FOR RAIN SIGNALS; W. G. Conway, Hartford, Conn. App. filed Feb. 20, 1915. Fuse device which becomes disrupted by a few drops of water.

1,174,935. RAILWAY-SIGNAL-LAMP CONTROLLER; W. K. Howe, Rochester, N. Y. App. filed July 10, 1915. Produces a subsequent dimming effect of the clear and danger signals.

1,174,939. ABSOLUTE PERMISSIVE AUTOMATIC BLOCK SIGNAL SYSTEM; W. W. Salmon, Rochester, and F. L. Dodgson, Gates, N. Y. App. filed Feb. 7, 1911. Designed particularly for single-track railways.

1,174,944. MOLTEN-BATH PROCESS FOR FIXING NITROGEN AND MEANS FOR EFFECTING THE SAME; J. E. Bucher, Coventry, R. I. App. filed Oct. 19, 1914. Uses molten carbon dissolving catalytic material.